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## Neighborhood Effects of Public Housing: How the Level of Public Housing Concentration Influences Neighborhood Crime Levels

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# Neighborhood Effects of Public Housing:

How the level of public housing concentration influences neighborhood crime levels

Paul Joice

Capstone in Public Policy

Martin School of Public Policy and Administration

University of Kentucky

*“Assisted housing policy increasingly has been concerned with providing residential opportunities for low-income and special needs households outside areas of concentrated poverty. In recent years, this concern has dominated policymaking at the U.S. Department of Housing and Urban Development...”*

*-George Galster, et. al.*

Thanks to: Tim Clay of the Louisville Police Department and Rebecca Matheny of the Louisville Metro Housing Authority for their help and cooperation.

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## I. Executive Summary

Public housing is plagued by the well known “not-in-my-backyard” (NIMBY) phenomenon. People may support the existence of public housing, but oppose it in their neighborhood. This is particularly relevant to “scattered site” public housing – which has a much lower density than “traditional” public housing – because, by its very essence, scattered site public housing will be “in more backyards”. Public protests against such programs have made it clear that people don’t care about the positive effects for the public housing tenants nearly as much as they care about perceived negative effects on *their neighborhood*.

My goal is to determine whether these perceived negative effects are indeed real. I use cross-sectional data from Louisville, Kentucky to estimate the relationship between both traditional and scattered site public housing, and the crime rate in the surrounding neighborhood. Using data obtained from the Louisville Police Department and the Louisville Metro Housing Authority, I find that each type is well suited to its typical use. Scattered site public housing, *in small quantities*, will not lead to an increase in neighborhood crime, while traditional public housing will. However, the marginal increase in crime is much higher for scattered site units. In fact, the addition of one traditional public housing unit at the margin is actually associated with a *decrease* in crime in my sample.

I conclude that there is no statistically significant relationship between scattered site housing and crime; therefore, opposition to small scale scattered site housing projects is not justified by the “there goes the neighborhood” argument. Although the following calculation is based on statistically insignificant results, it appears that scattered site housing will not increase neighborhood crime unless the unit density approaches 50 units per square mile – a level attained by only one census tract in Louisville. Below this level, scattered site housing may actually decrease crime.

However, scattered site housing is not a panacea. When public housing with a scattered site form and label approaches the density of traditional public housing (greater than 50 units per square mile), it could have a more adverse impact on the community than a traditional public housing project would have. Thus, when it is necessary to provide many new units, traditional, high density public housing may be the better alternative.

## II. Public Housing: Justifications and Objectives

The United States government has been involved in the regulation of the housing industry since the turn of the 20<sup>th</sup> century, and has been directly providing housing since the U.S. Housing Act of 1937. Although such involvement is not justified by a market failure, it seems that Americans are more concerned with equity than efficiency when it comes to guaranteeing shelter – one of the most fundamental needs that humans have. The particular form of this involvement has changed drastically over the past 40 years, and continues to be a subject of debate today.

Today, the question is not whether or not the government should provide housing assistance, but how it should do so. Early public housing projects had the sole objective of supplying shelter at below market rates for those who were deemed needy. But as a wide range of literature – from academic studies to popular books like There are No Children Here – has shown, this practice led to a host of problems. While the public housing residents did indeed have a roof over their heads, they also had drug dealers on the street corners, terrible schools, and few positive role models. All this combined to trap public housing residents in a vicious cycle of poverty. The recognition that the form of public housing can have incredibly important consequences for all aspects of life for the recipients of the assistance led to a new objective. Public housing should not merely be a place to live. It should be a *safe* place to live, where the poorest Americans can take advantage of opportunities to improve their lot (and their children's lot) in life.

This paper analyzes one of the methods by which this goal might be reached: “deconcentrating” poverty by breaking up massive, consolidated public housing projects into “scattered site” projects. This policy of dispersed public housing is contrasted with the status quo – traditional public housing.

### III. Explanation of Concepts and Variables

The two general types of public housing assistance I will analyze are both rental programs for units owned and administered entirely by government housing authorities. This excludes Section 8 housing – one very common and well known method of dispersing public housing. There are two reasons I will not study Section 8. First of all, there is already an abundance of research on Section 8 housing vouchers (Olsen 2000, 2006, 2006). Second, the location of Section 8 residents is incredibly sensitive information, which the Louisville Metro Housing Authority was unwilling to release to me.

The two types of public housing I am interested in are “traditional” public housing and “scattered site” public housing. The primary difference between the two is the number of units that each project includes and the density of these units (see Table 1). Therefore, my explanatory variable of interest is a measure of concentration, with traditional and scattered site housing being at opposite ends of a continuum.

Table 1: Traditional vs. Scattered Site Public Housing

	Description of housing projects and their operation
“Traditional” Public Housing	The government entity constructs, owns, and operates a housing development specifically for housing assistance recipients. Rents and eligibility are determined by the government by established procedures. These projects are typically densely populated, with many units in each project/complex. A popular empirical question is whether such a high concentration of poverty causes many social ills associated with public housing.
“Scattered Site” Public Housing	The government entity constructs, owns, and operates the housing development, just like with traditional public housing. However, the style of the development is different; units are spread out in an attempt to deconcentrate poverty, and often incorporated into mixed income neighborhoods.

Having chosen the explanatory variable, my next task is to choose a dependent variable. Doing so requires some thought as to how a public housing program should be evaluated. The purpose of scattered-site public housing is twofold:

1. As with any public housing, the primary purpose is to provide housing at below market rates to families and individuals who do not have an income considered sufficient to obtain decent housing in the private market.
2. The added goal of scattered-site housing is to provide an environment in which public housing residents will have a better chance to lift themselves out of poverty.

A sensible way to evaluate scattered-site housing would be to see whether or not it does actually achieve its second goal and help its residents escape the poverty trap. Evaluating scattered-site public housing by the effect it has on its inhabitants is certainly a very important task; however, it is not my focus. The reason for this is that public housing is rarely judged in the public by such criteria.

Public housing is plagued by the well known “not-in-my-backyard” (NIMBY) phenomenon. People may support the existence of public housing, but oppose it in their neighborhood. This is particularly relevant to scattered-site public housing because, by its very essence, scattered-site public housing will be “in more backyards”. The theory is that by mixing public housing, in small doses, in with market rate housing, the effects on the public housing residents will be positive. However, those living in the market rate housing have shown strong objections. Public protests against such programs – notable examples being in Baltimore and Denver – have made it clear that people don’t care about the positive effects for the public housing tenants nearly as much as they care about perceived negative effects on *their neighborhood* (Galster and Zobel 1998).

My goal is to determine whether these perceived negative effects are indeed real, using Louisville, KY as a case study. Therefore, my unit of analysis will be the neighborhoods of Louisville and my dependent variable will be one of the most important indicators of neighborhood quality: crime rate. But how will I determine a “neighborhood”? It must be in such a way as to allow the collection and analysis of data. The most convenient and consistent way to do this is to use census tracts. This is, admittedly, an imperfect measure of a neighborhood. Among Louisville’s 170 census tracts, the median size is 1.21 square miles, which is larger than UK’s campus (1.05 square miles), and larger than what many people think of as a neighborhood.

However, this imprecision does have a benefit, in that it limits the problem of spillovers. Consider what would happen if my unit of analysis were census blocks – a much smaller subunit of census tracts. One block could be entirely composed of public housing, with the surrounding blocks having zero public housing. Yet those surrounding blocks would not exhibit the crime rates one would expect from an area with zero public housing; the effects of the public housing block would spill over into the surrounding blocks. By using a larger area of analysis like the census tract, it becomes less likely that a public housing project will be directly on the boundary of a neighborhood. The effects of the explanatory variables are contained within the unit of analysis, and spillover effects are diminished.

#### **IV. Literature Review**

Before proceeding with the analysis of Louisville, it will help to consider what similar studies have already been done on public housing, crime, and the relationship between the two. Botein and Freeman (2002) conduct a review of the extant evidence of



the effects that public housing has on the surrounding neighborhood. They consider four commonly assumed consequences of public housing: decreased property values, racial transition (from white to minority), increased poverty concentration, and increased crime. They astutely point out that public housing causes these changes in two distinct ways: a change in the physical character of the buildings, and a change in the neighborhood's residents. Thus, the physical nature of a public housing project can have an effect entirely independent of the effect its residents have. This idea originates from Oscar Newman's theory of "defensible space" (1972); he argues that the high density construction of traditional public housing inhibits the development of social networks, and reduces the ability of a community to monitor (defend) its common space. This suggests a possible fixed effect due to the presence of a certain type of public housing in a neighborhood, plus a variable effect due to the number of public housing residents in the neighborhood.

McNulty and Holloway (2000) study the possibility that some of the empirically established association between crime and race might be mediated through proximity to public housing. They conduct a cross-sectional analysis of Atlanta, using 1990 census block groups as their unit of analysis. Their dependent variable is crime rate per 1,000 population and their independent variable is distance from a block that includes public housing (blocks that contain public housing = 0). They control for:

- residential stability (residents who have been in their home more than 5 years);
- vacancy rate;
- percent of the population aged 15-24 (the most likely to commit crimes); and
- a "disadvantage index" (a combination of poverty rate, households headed by females, unemployment rate, and public assistance rate)

They confirm their theoretical expectation that as distance from public housing increases, crime decreases, and that including this public housing variable does mediate some of the effects that would otherwise be attributed to race. However, the public housing variable in this study does not consider the type or amount of public housing.

Santiago et. al. (2003) also study the effect of proximity to public housing on neighborhood crime, but unlike McNulty and Holloway they do consider the form of that public housing. They are specifically interested in the effect that the opening of 38 new dispersed housing units in Denver, from 1990-97, had on crime rates in the surrounding neighborhoods. Their sophisticated analysis includes pre- and post- controls for selection bias, thereby addressing the failure of previous studies to show causality. This is done by constructing concentric rings around each of the 38 new housing sites, estimating crime trends before and after the opening of the site, and using the pre- and post- crime trends for the rest of the city as a comparison group. They also incorporate necessary adjustments for spatial autocorrelation and heteroscedasticity. The results of this analysis show that the opening of a new site does *not* cause a significant increase (even at the 10% level) in the level or the trend of crime within 2000 feet of the site. In fact, they find some evidence that opening these sites may effect a decrease in crime.

However, the average number of households at each of these 38 sites is only 1.48; most of the sites are simply single-family homes purchased by the Denver Housing Authority for use by public housing residents. Their conclusion that an individual site does not increase crime doesn't imply that a scattered site *project* (with several sites) would have no effect. Therefore this study has very limited applicability to larger scale scattered site housing programs.

Of the articles referenced above, I believe that Santiago et. al. have the most complete, impressive model. However, such a model requires both more extensive data and more GIS (geographic information systems) expertise than I have. In addition, its limited external validity is a weakness. The model used by McNulty and Holloway fits my capabilities and my data very well.

None of the articles referred to so far have directly incorporated concentration of public housing into their models. Thus, further consultation of the theoretical literature is necessary to determine the appropriate form of my explanatory variables. The critical question is whether the relationship between public housing concentration and crime is linear, or more complex. According to Galster and Zobel (1998), answering this question is equivalent to answering whether or not dispersion of public housing has net social benefits. If there is a simple linear relationship between public housing concentration and crime, removing one unit of public housing in neighborhood A and placing it in neighborhood B will not change crime levels for society as a whole. The change in crime for the two neighborhoods will exactly offset. On the other hand, if there is an exponential relationship between public housing concentration and crime – if public housing has an increasing marginal effect on crime – then there would be a net benefit to society as a result of deconcentration. In the same paper, Galster and Zobel conduct a meta-analysis of the extant research and conclude that existing evidence on the nature of this relationship is “thin and contradictory”.

## **V. Data Collection**

I have been able to obtain the cooperation of both the Louisville Metro Housing Authority (LMHA) and the Louisville Police Department (LPD). I also use the 2000

Census to assemble demographic characteristics for control variables. LMHA provided me with a database of all 4,082 public housing units they administer (as of November 2006), both traditional and scattered site. This does not include Section 8 housing, for privacy reasons. For each unit, LMHA was able to tell me its address, the census tract in which it is located, the project that it is a part of, and whether that project is considered traditional or scattered site. The 4,082 units are grouped in 27 separate projects, in a total of 42 census tracts. Of these, 12 projects containing 331 units are considered scattered site, while 15 projects containing 3,751 units are considered traditional public housing. The 12 scattered-site projects are contained in 33 census tracts (some projects span multiple tracts), and the 15 traditional projects are contained in 13 census tracts. Four census tracts contain both types of housing.<sup>1</sup>

Scattered Site Housing	12 projects	33 census tracts	331 units
Traditional Housing	15 projects	13 census tracts	3,751 units
<b>Total Public Housing</b>	<b>27 projects</b>	<b>42 census tracts</b>	<b>4,082 units</b>

From LPD, I was able to obtain a database of all 36,963 crimes reported in 2006 in Louisville, including the type of crime and the address where it was committed.<sup>2</sup> Unfortunately, LPD’s computer system does not allow them to accurately group crimes by census tract. Therefore, I used GIS mapping software to geocode the crimes and match them to a census tract. As a result of imperfections in the data, I successfully matched only 25,050 (out of 36,963) crimes to the census tract where they occurred (see Appendix A for details).

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1. Data was obtained from LMHA through Rebecca Matheny ([Matheny@lmha1.org](mailto:Matheny@lmha1.org))

2. Data was obtained from LPD crime analyst Tim Clay ([Tim.Clay@louisvilleky.gov](mailto:Tim.Clay@louisvilleky.gov))

## VI. Methodology and Analysis

My task is to establish a relationship between public housing and neighborhood crime rates, and to show how this relationship varies as the level of concentration of public housing varies. To identify this correlation, I calculate a series of increasingly complex regressions, culminating with a multivariate regression model with several controls.

The first two models I estimate are simple bivariate regressions of 1) *crimerate* (crimes per 1,000 people) on *phdensity* (public housing units per square mile), and 2) *crimerate* on *PH* (a dummy variable indicating the presence of public housing). Both models are significant, with R-squared of .056 and .152, respectively. This confirms the theoretical expectation that crime rate and public housing are correlated. However, it ignores many other important factors and should be only lightly considered.

$$\text{Model 1: } crimerate = 37.4 + .049phdensity + e \\ (3.1) \quad (.015)$$

$$\text{Model 2: } crimerate = 30.26 + 36.9PH + e \\ (3.3) \quad (6.7)$$

Next, I regress crime rate on a set of four variables indicating the presence and density of both types of public housing. The purpose of this series of more targeted variables is two-fold. First, it will distinguish between the two types of public housing (scattered site and traditional), which is the goal of this research. Second, it helps me determine *how* public housing affects crime rate. As shown in previous research (Freeman and Botein 2000, Newman 1972), public housing influences neighborhood crime through two mechanisms: changing the built environment and changing the inhabitants. A variable indicating the presence of a certain type of public housing accounts for the physical change in the neighborhood, while the number and density of

units accounts for the change in the neighborhood's residents. Accordingly, my third model uses the following four explanatory variables:

- *SS*: dummy variable indicating presence of scattered site housing
- *TR*: dummy variable indicating presence of traditional housing
- *SSdensity*: continuous variable indicating density (units per square mile) of scattered site housing
- *TRdensity*: continuous variable indicating density (units per square mile) of traditional housing

$$\text{Model 3: } \text{crimerate} = 31.1 + 10.7SS + .864SSdensity + 39.6TR + .005TRdensity + e$$

(3.3)    (9.8)        (.374)            (14.2)    (.019)

This third model (F=9.5; R-squared=.187) produces some interesting results. All four variables have positive coefficients, but only two of the four are significant at the .05 level: *TR* and *SSdensity*.. The presence of traditional public housing has a significant (and large) impact on crime rate. All else equal, census tracts with a traditional public housing project have approximately 40 more crimes per 1,000 people than census tracts without such a project. However, the effect of the density of traditional public housing units is not significant. In other words, it does not matter whether a massive public housing project has 500 or 800 units; what matters it that it is massive. With scattered site housing, the opposite is true. The presence of a scattered site project does not have a significant impact on neighborhood crime, but increasing the density of such a project does. For example, an additional 20 scattered site units, on average, would be associated with an increase of about 17 crimes per 1,000 people.

Even the third model, with its more complex explanatory variables, does not paint a complete picture. To do that, control variables must be included. Otherwise, I cannot be

confident that my explanatory variables are uncorrelated with the error term, and my estimates may be biased. Based upon my review of the literature, I incorporate the following neighborhood characteristics as control variables in the fourth and final model:

- *Poverty*: percent of the population of the census tract living below the poverty line. High levels of poverty are expected to increase crime because poverty limits opportunities and may necessitate criminal behavior. Crime can also limit opportunities and increase neighborhood poverty.
- *Black*: percent of population of the census tract that is black. Race may be a proxy for otherwise unmeasurable characteristics of a person or community that affect propensity to commit crime.
- *Youngmale*: percent of population of the census tract that is male, aged 15-24. This is the demographic group most likely to commit crime. Large numbers of young males should be expected to increase crime.
- *Owned*: percent of housing units in the census tract that are owner occupied. This is an indicator of residential stability. High levels of home ownership indicate a stable community and should decrease crime.
- *Vacant*: percent of housing units in the census tract that are vacant. Vacant buildings can increase crime by serving as hideouts for criminals, and are also an indicator of economic distress. High vacancy rates should correlate with high crime.

These five control variables are included because they can reasonably be expected to influence neighborhood crime. Of course, it may be argued that there are many more variables that merit inclusion. I have settled on these five based on their prevalence in the existing literature, and in order to maintain a parsimonious model.

$$\begin{aligned}
 \text{Model 4: } \text{crimerate} = & 7.8 - 13.15SS + .274SSdensity + 33.83 TR - .047TRdensity \\
 & (17.7) \quad (8.5) \quad (.306) \quad (11.3) \quad (.021) \\
 & -.26black - .22owned + 3.53vacant + 1.34poverty + 1.48youngmale + e \\
 & (.125) \quad (.177) \quad (.911) \quad (.395) \quad (1.07)
 \end{aligned}$$

Model 4 is statistically significant, with an F statistic of 18.14, and an adjusted R-squared of .477. The coefficients of the four public housing variables in model 4 show results similar to those of model 3. Again, there is a significant and large increase in crimes per 1,000 people accompanying the presence of a traditional public housing project. However, as the density of these units increases, crime rate actually decreases very slightly. With scattered site housing, the presence of a project seems to be associated with a fairly large decrease in crime rate, while increased density leads to increased crime. However, neither scattered site variable coefficient is statistically significant.

Among the control variables of model 4, there are few surprises. The negative coefficient on *black* lends support to the conclusions of McNulty and Holloway (2000); while areas with a high proportion of black residents often exhibit higher crime, this effect is apparently mediated through the inclusion of public housing and other control variables. Another notable product of model 4 is the substantial impact of vacancy rate. Whether vacant buildings actually provide a haven for crime or are merely a proxy for general neighborhood blight, they do show a significant and fairly large effect on crime rate. A 1% increase in the vacancy rate is associated with an increase of 3.53 crimes per 1,000 people.



## VII. Limitations of Analysis

This analysis is subject to some fairly significant limitations. Most important among these is the problem of endogeneity. I am unable to say whether public housing *causes* crime. It is likely that public housing is placed in areas that have high crime to begin with, because of the lower property values in these areas. One way to correct this is with the inclusion of an instrumental variable (IV). The IV would have to be highly correlated with public housing, uncorrelated with the error term of the model, and not directly causing crime. Some potential IVs for public housing concentration include:

- overall housing concentration
- disabled/elderly public housing (which is not included in my data set)
- alternative public housing sites (sites that were considered but not ultimately chosen)

Of these, the only one readily available to me – overall housing concentration – is also probably the weakest.

The ideal way to eliminate endogeneity in this case would be with better data, extended over time. Because of the recent consolidation of the Jefferson County and Louisville governments, LPD does not have reliable historical data beyond 2004, and as a result, I was limited to a cross-sectional analysis. But if multiple years of data were available, encompassing a period of substantial change in the location of public housing projects, a longitudinal analysis would be far superior.

Another significant problem is the poor distribution of the data. Of the 170 census tracts in Louisville, only 42 have any public housing at all (containing a total of 4,082 units). Of those 42 census tracts with public housing, only 9 have more than 50 units; these 9 census tracts account for 91.6% of the city's public housing. There may also be

some question of the validity of the crime statistics. A glance at a scatterplot shows that one particular census tract was the home of 1001 crimes (4.2% of the total), which is over 7 times the average for Louisville. With both crimes and public housing being heavily skewed, estimating a relationship between the two may be like trying to hit a raindrop with a pebble. Furthermore, difficulties in the geocoding process (detailed in Appendix A) suggest a possibility that the crimes I was able to successfully geocode may not be representative of the entire set of crimes committed. Similarly, as with all crime research, if some crimes go systematically unreported, then my crime statistics will not be representative of the true level of crime taking place.

The final issue with the crime data is that I chose to include *all* types of crimes in my analysis; not just violent crime. I felt using only violent crime would be an unnecessary complication; while public housing in general might be more associated with violent crime, the inclusion of all crimes should not inject bias into the comparison of two types of public housing. Therefore, this is not a *problem*, per se, but must be noted when interpreting my results.

## **VIII. Conclusions**

My most comprehensive model (model 4) suggests that in Louisville, the presence of traditional public housing causes a significant increase in crime, but that adding additional units to a project does not increase crime further. Meanwhile, the presence of scattered site housing may actually decrease crime, but this could be offset as more units are added.

The obvious conclusion to be drawn from this is that both types of public housing are good at what they're meant for. Consider the challenge of placing 400 new units in a

one square mile census tract that currently has no public housing. Using model 4, and assuming causality, 400 new scattered site units would lead to an increase of 96.45 crimes per 1,000 people in the census tract. If those 400 units were built in a traditional project, there would be an increase of only 15.03 crimes per 1,000. Obviously, this example is somewhat absurd; a 400 unit scattered site project would be so dense it could not be considered “scattered”. In the 33 census tracts that do contain scattered site housing, the average number of units is 10. If the above example were calculated for 10 units instead of 400, the scattered site project would have an impact of -10.41 crimes per 1,000; a decrease!

What is the level at which scattered site housing becomes too dense? This can be answered by examining the total effect of scattered site housing on crime. In Model 4, this is accounted for by:  $-13.15SS + .274SSdensity$ . When these two terms are equal, scattered site housing has zero effect. Solving for  $SSdensity$  suggests that when the density of scattered site units in a census tract exceeds 48 units per square mile, there will be a net increase in crime for that census tract (this assumes  $SS = 1$ ). As a result, it seems reasonable to recommend that scattered site projects be limited to a density of less than 48 units per square mile. Currently, Louisville has only one census tract with a scattered site housing density above this threshold.

Furthermore, it should be noted that scattered site housing can have a beneficial impact on the vacancy rate, which I have shown to be another significant determinant of neighborhood crime. A well designed scattered site housing project could rehabilitate vacant, run down homes, further decreasing crime.

Perhaps the most important conclusion to be drawn is that more research on this issue is needed. Continuing to collect data for future years and developing a data set

suitable for a panel study could allow for a much more powerful analysis that would address many of the problems I have encountered, especially the inability to infer causality. While my data suggests that a well-operated scattered site housing project *will not* lead to increased crime, stronger causal evidence may be needed to assuage the fears of “NIMBY” homeowners who expect a crime wave to take over their neighborhood.

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## **Appendix A: Data Collection, Problems and Solutions**

The primary problem I had in assembling a data set was standardizing all my different data sources. In order to be able to describe a neighborhood by a set of variables, each data source had to have a consistent definition of “neighborhood”. I realized exactly how difficult this would be when I discovered that even the most widely used geographic units – census tracts – were not identical between LPD, LMHA, and the true authority: the census. The cause of this appears to be that LHMA and LPD are using outdated census tract boundaries in their systems. As a result, I was forced to verify a significant percentage of the LMHA addresses through the Census database. I am extremely confident in my revised tabulations.

Solving the problem with the LPD data was more difficult because the extreme number of records (36,963) prevented me from verifying them one by one. Therefore, I used GIS mapping software to geocode the crimes, matching them against a “road layer” from the Census TIGER database. Then I matched this “road layer” to a “census layer”. This process can be seen in Figures 1-3 below. Due to incomplete addresses in the LPD crime database, many crimes could not be mapped out accurately. Additionally, some of the crimes that were mapped (at 2006 addresses) could not be matched to the Census tract database (from 2000). As a result, of the 36,963 crimes committed, I was able to successfully match 25,050 of them to the census tract where they occurred. As long as the 11,913 missing observations are randomly distributed, this is not a problem. The one significant concern I have is that the addresses that could not be matched to the year 2000 census might be recent suburban developments. If this is the case, crime in these suburban census tracts would be underrepresented in my data set.

To view these data sets, feel free to contact me at [PJoice@gmail.com](mailto:PJoice@gmail.com).

Figure 1: Louisville Census Tracts (light blue)

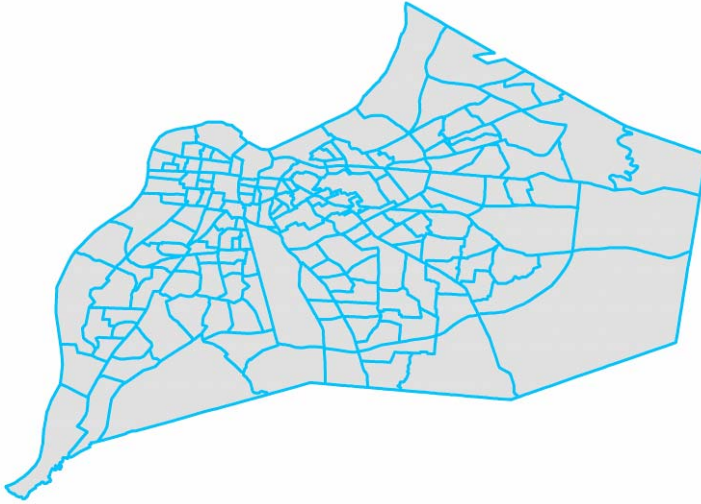


Figure 2: Louisville Census Tracts (light blue), with Roads (dark blue)

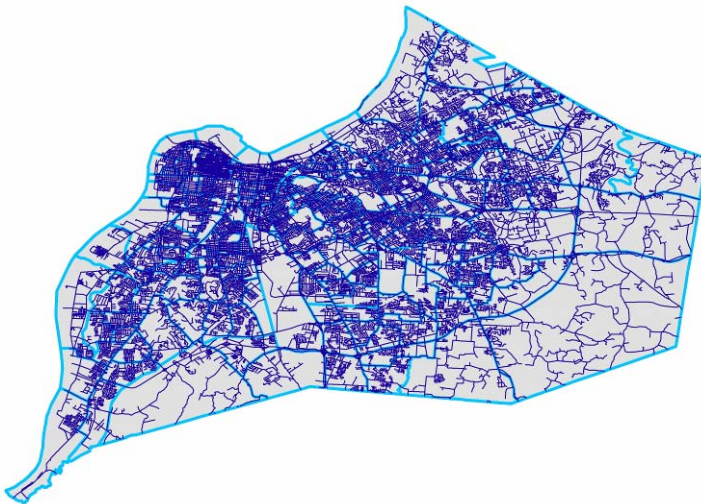
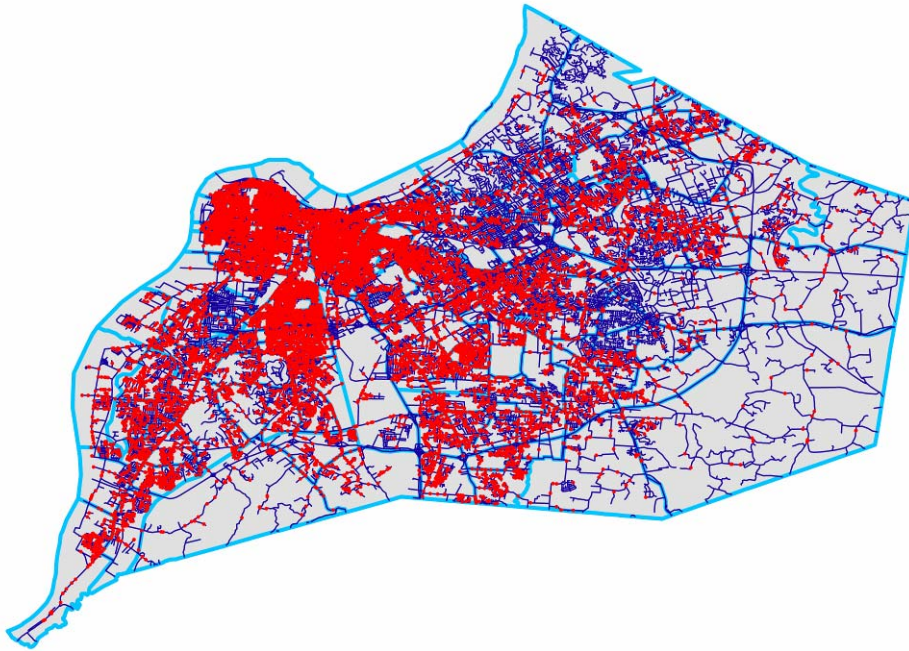


Figure 3: Census Tracts (light blue), Roads (dark blue), and Geocoded Crimes (red)





## Appendix B: Summary of Crime Statistics, Tallied by Quarter and Type of Offense

### First Quarter 2006

Assault	917
Burglary/Theft	6928
Murder	18
Rape	71
Other	261
Total	8195

### Second Quarter 2006

Assault	1075
Burglary/Theft	8168
Murder	25
Rape	77
Other	250
Total	9595

### Third Quarter 2006

Assault	1070
Burglary/Theft	8331
Murder	9
Rape	58
Other	230
Total	9698

### Fourth Quarter 2006

Assault	988
Burglary/Theft	8190
Murder	17
Rape	53
Other	227
Total	9475

## Appendix C: Data Analysis and Statistical Output

Tabulated results of Model 3:

Variable	Coefficient	Std. Err.	t-value	P-value
SS	10.678	9.800	1.09	0.277
TR	39.591	14.172	2.79	0.006
SSdensity	0.864	0.374	2.31	0.022
TRdensity	0.005	0.019	0.28	0.784
Constant	31.098	3.264	9.53	0

STATA summary of Model 3:

```
. reg crimerate SS TR ssdensity trdensity
```

Source	SS	df	MS	Number of obs =	170
-----+-----					
Model	52823.3918	4	13205.848	F( 4, 165)	= 9.50
Residual	229295.099	165	1389.66727	Prob > F	= 0.0000
-----+-----					
Total	282118.491	169	1669.34018	R-squared	= 0.1872
				Adj R-squared	= 0.1675
				Root MSE	= 37.278

crimerate	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]	
-----+-----						
SS	10.67843	9.799638	1.09	0.277	-8.670424	30.02728
TR	39.59098	14.17226	2.79	0.006	11.60862	67.57333
ssdensity	.8635914	.3744854	2.31	0.022	.1241902	1.602993
trdensity	.0052225	.0189814	0.28	0.784	-.0322553	.0427003
_cons	31.0981	3.263759	9.53	0.000	24.65398	37.54221
-----+-----						

Tabulated results of Model 4:

Variable	Coefficient	Std. Err.	t-value	P>t
SS	-13.152	8.504	-1.55	0.124
TR	33.833	11.310	2.99	0.003
ssdensity	0.274	0.306	0.9	0.372
trdensity	-0.047	0.021	-2.26	0.025
black	-0.264	0.125	-2.11	0.037
owned	-0.223	0.177	-1.26	0.208
vacant	3.528	0.911	3.87	0
poverty	1.343	0.395	3.4	0.001
youngmale	1.477	1.069	1.38	0.169
constant	7.833	17.670	0.44	0.658

STATA summary of Model 4:

. reg crimerate SS TR ssdensity trdensity black owned vacant poverty youngmale

Source	SS	df	MS	Number of obs = 170
Model	142487.738	9	15831.9709	F( 9, 160) = 18.14
Residual	139630.753	160	872.692208	Prob > F = 0.0000
Total	282118.491	169	1669.34018	R-squared = 0.5051
				Adj R-squared = 0.4772
				Root MSE = 29.541

crimerate	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]	
SS	-13.1519	8.503781	-1.55	0.124	-29.94603	3.642227
TR	33.83302	11.31017	2.99	0.003	11.49655	56.16949
ssdensity	.2743096	.3064885	0.90	0.372	-.3309751	.8795942
trdensity	-.0467985	.0206925	-2.26	0.025	-.0876641	-.0059329
black	-.2641915	.1253975	-2.11	0.037	-.5118391	-.0165438
owned	-.2234706	.1767672	-1.26	0.208	-.5725685	.1256273
vacant	3.527806	.9110682	3.87	0.000	1.728536	5.327076
poverty	1.343428	.3952026	3.40	0.001	.5629418	2.123914
youngmale	1.477375	1.068977	1.38	0.169	-.6337495	3.5885
_cons	7.833089	17.67019	0.44	0.658	-27.06379	42.72997