

The ambient population and crime analysis



Martin A. Andresen

andresen@sfu.ca

School of Criminology

Institute for Canadian Urban Research Studies

Simon Fraser University

<http://www.sfu.ca/~andresen>

The crime rate

$$\text{Crime Rate} = \left(\frac{\text{Number of Criminal Occurrences}}{\text{Population at Risk}} \right) * \text{Scalar}$$

- A measure of risk ~ offending and victimization
- The three components to the crime rate

The population at risk

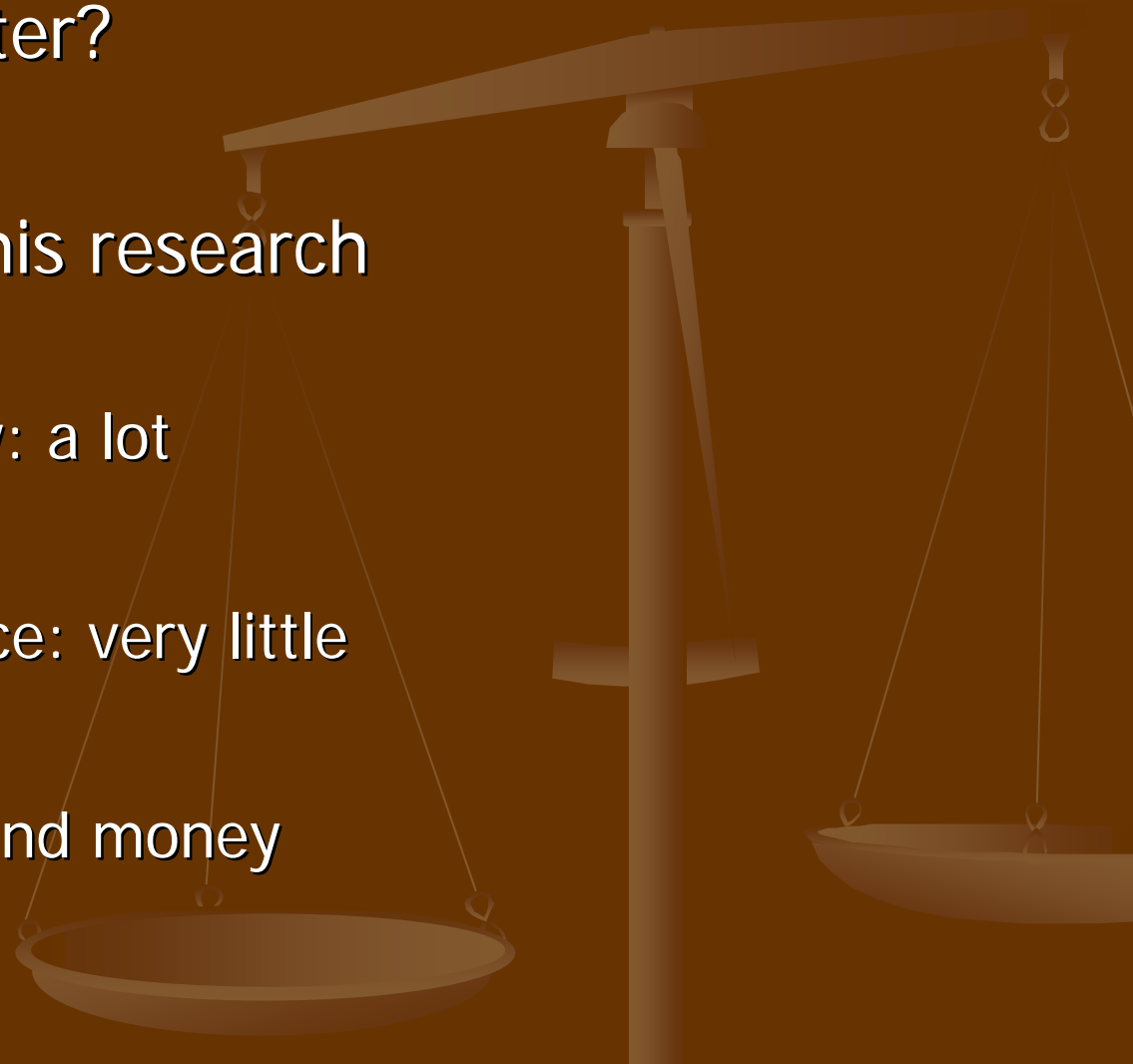


- Are all people equally likely to be a victim of crime?
- Are all people equally likely to be a criminal offender?
- A theoretically-informed crime rate

Sarah Boggs and Keith Harries

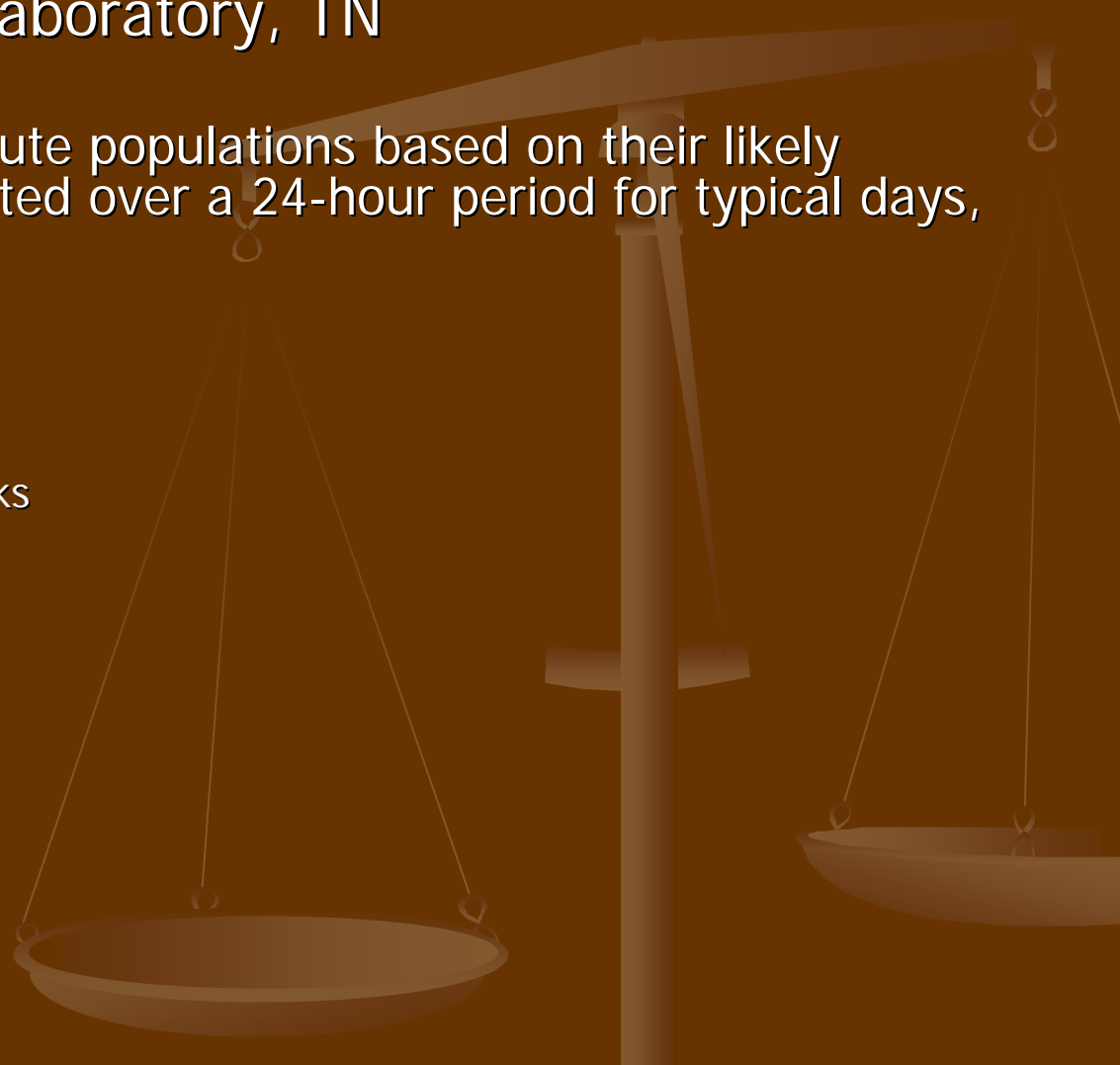
- “[s]ince the number of events, or the numerator, varies with the type of crime, the denominator should likewise vary so that the whole number of exposures to the risk of that specific event is incorporated as the base” (SB)
- “[a] valid rate, however, should form a probability statement, and therefore should be based on the risk or target group appropriate for each specific crime category” (SB)
- The denominator should be used to provide “an adjustment for environment risk or opportunity” (KH)
- The crime rate only has the *potential* to be a useful statistic (KH)

- What are the appropriate denominators?
- Does it really matter?
- The outcome of this research
 - In terms of theory: a lot
 - In terms of practice: very little
 - High costs: time and money

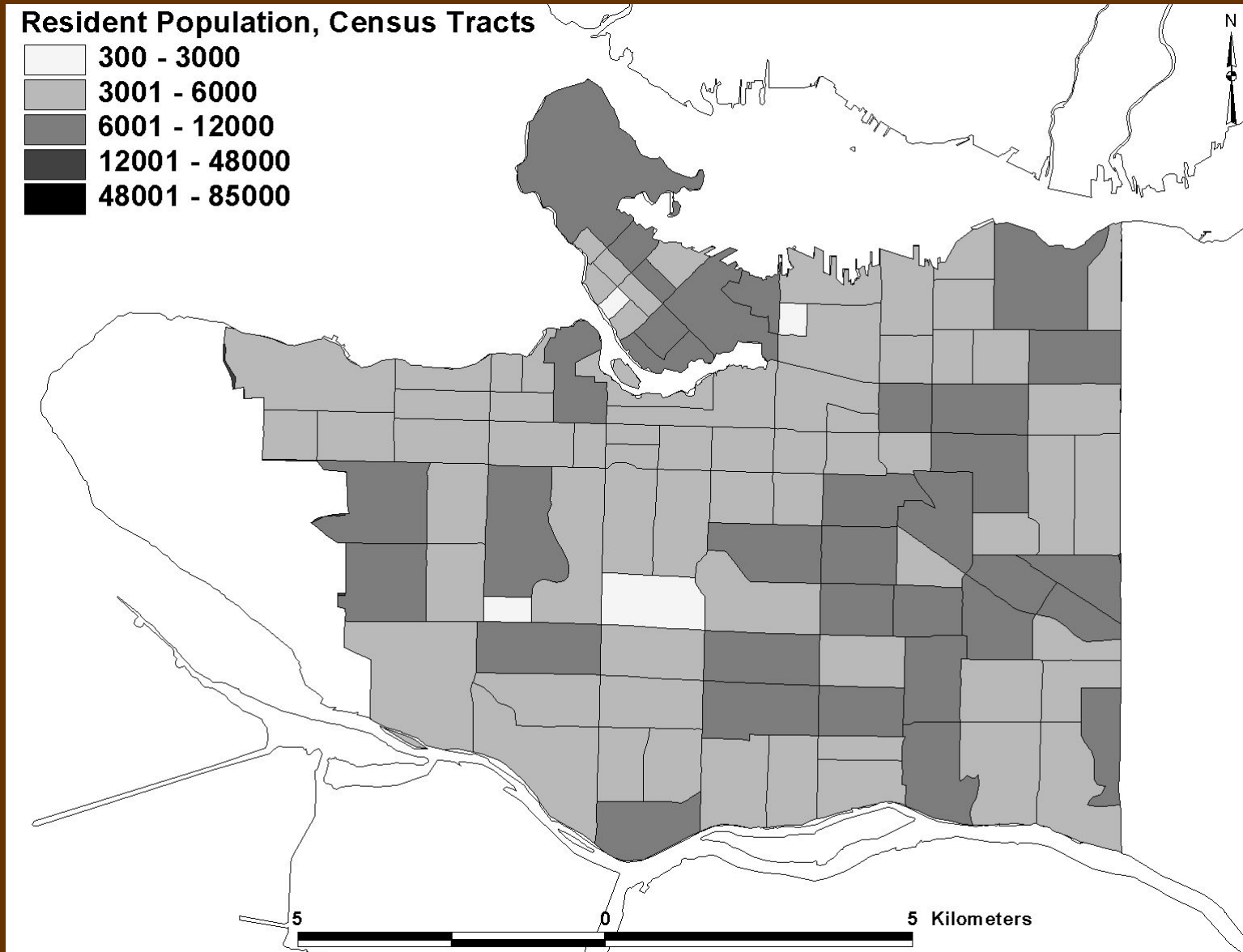


The ambient population

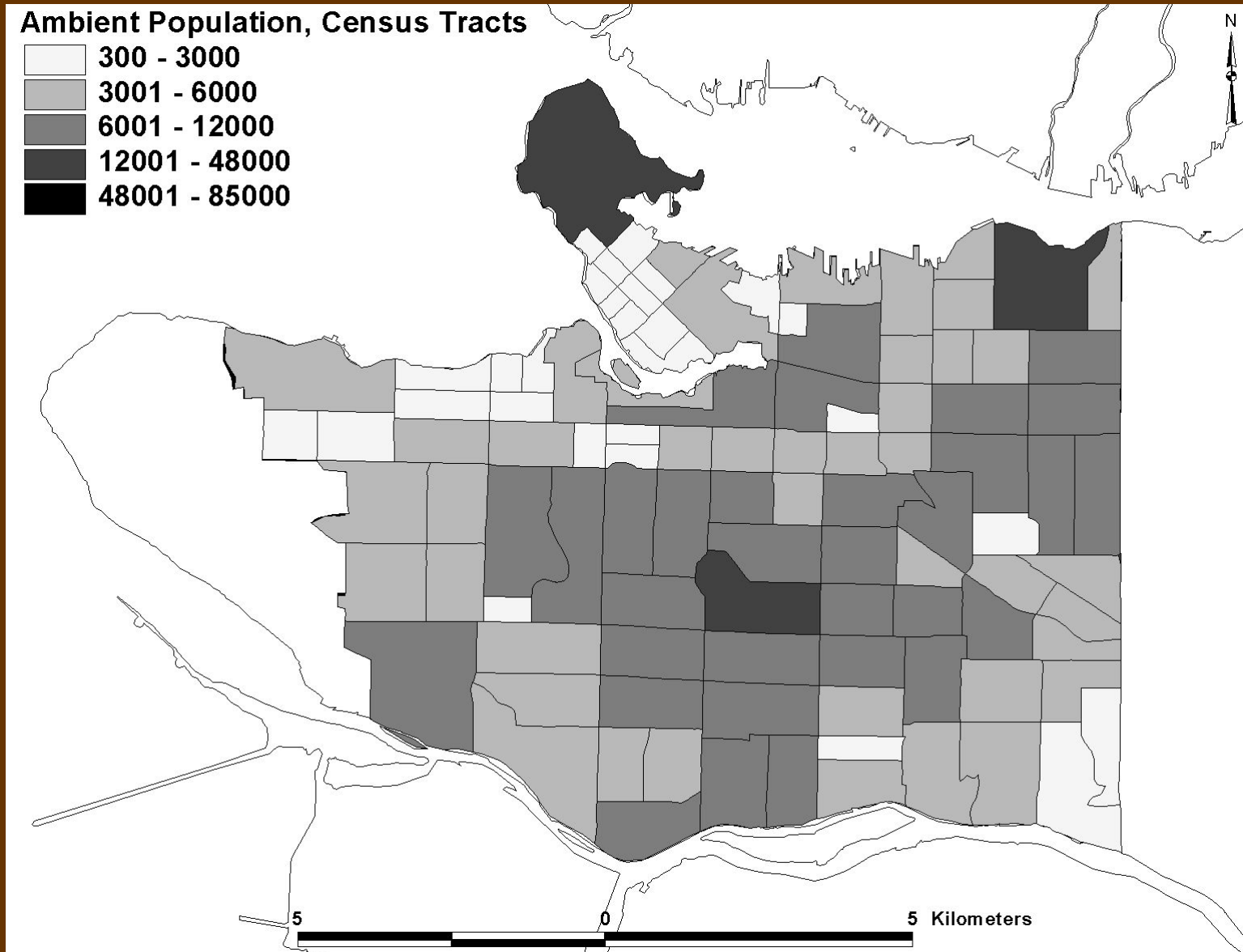
- Oak Ridge National Laboratory, TN
- its purpose is to distribute populations based on their likely ambient locations integrated over a 24-hour period for typical days, weeks, and seasons"
- How is it calculated?
 - Transportation networks
 - Slope
 - Land cover
 - Nighttime lights



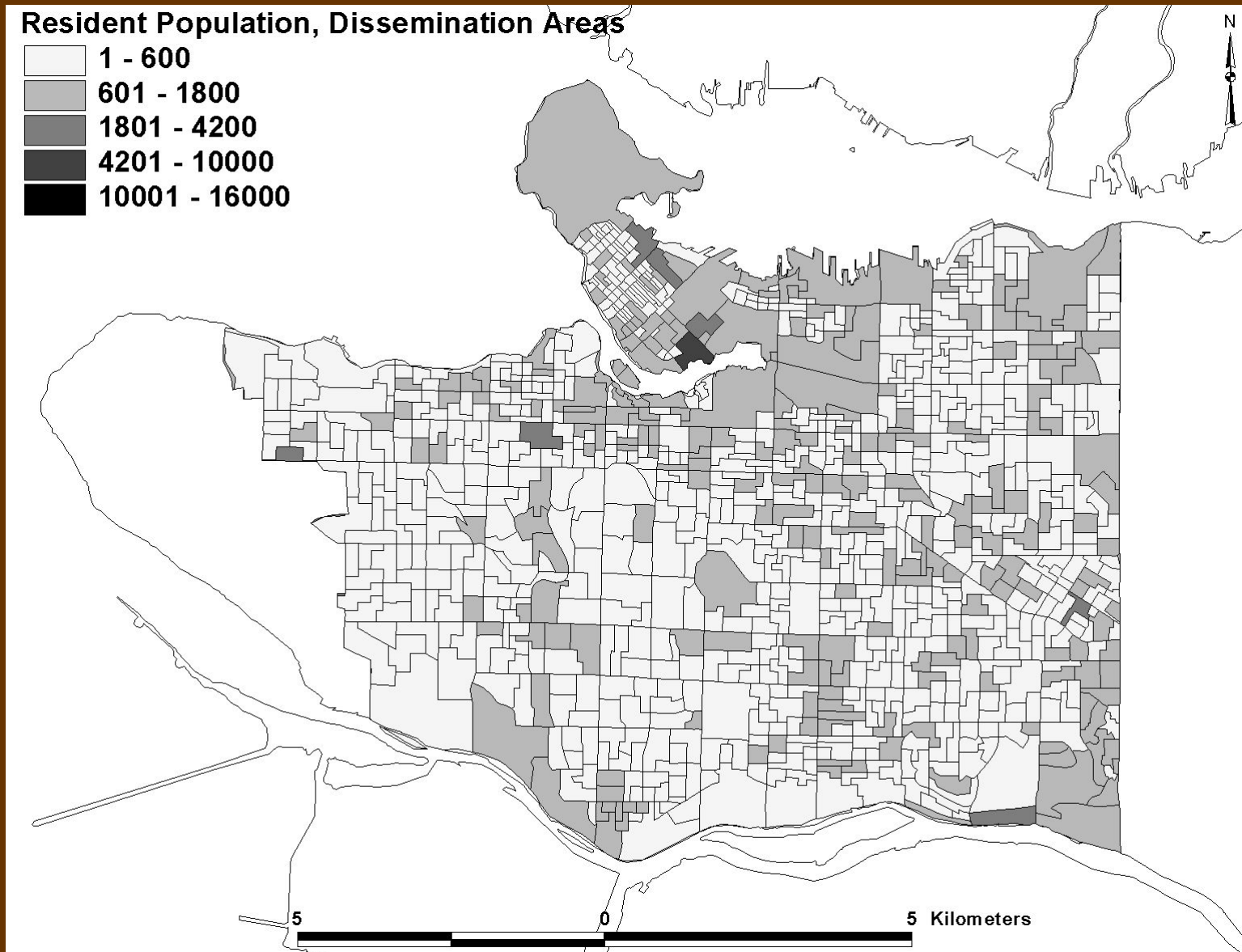
2001 Census Tracts



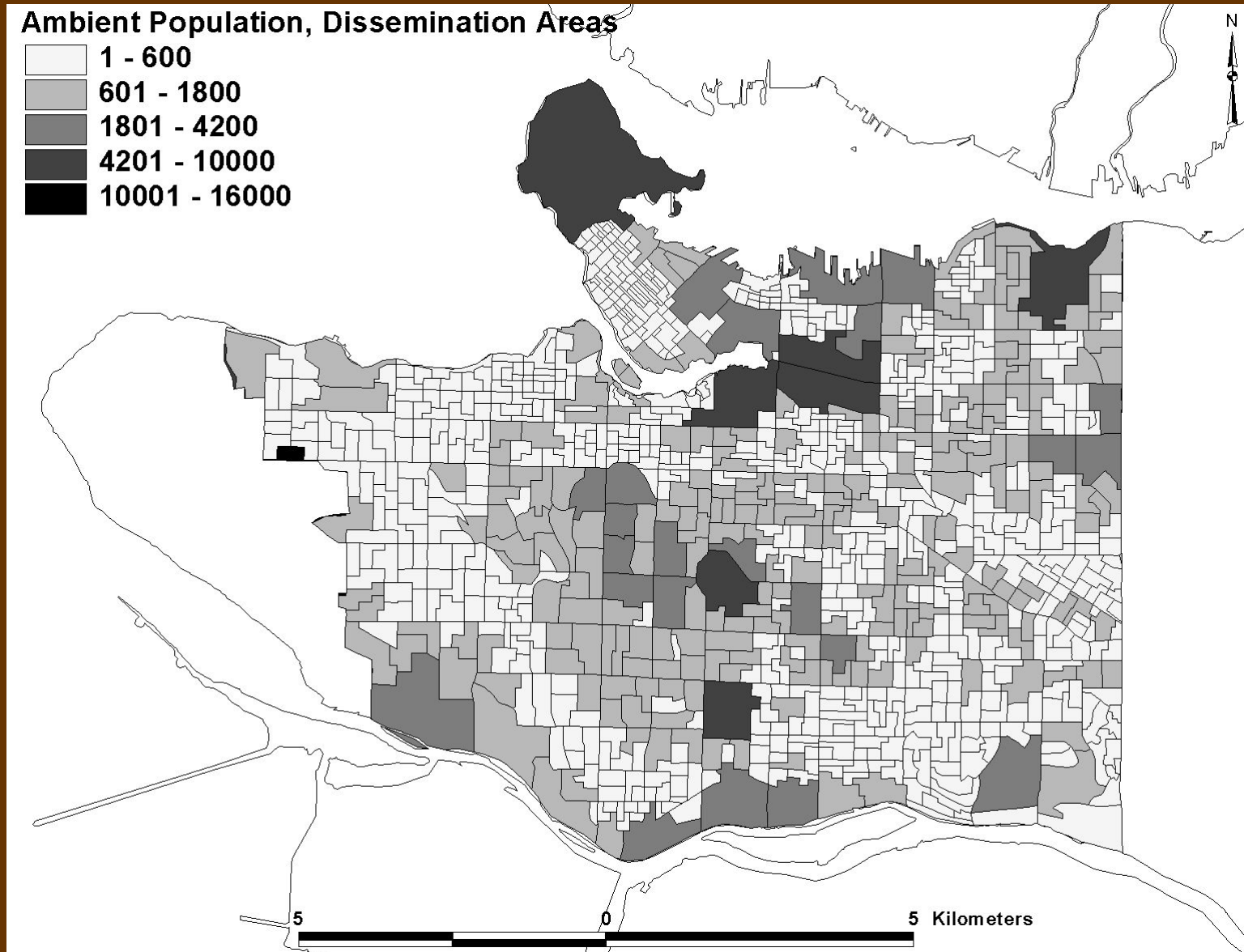
2001 Census Tracts



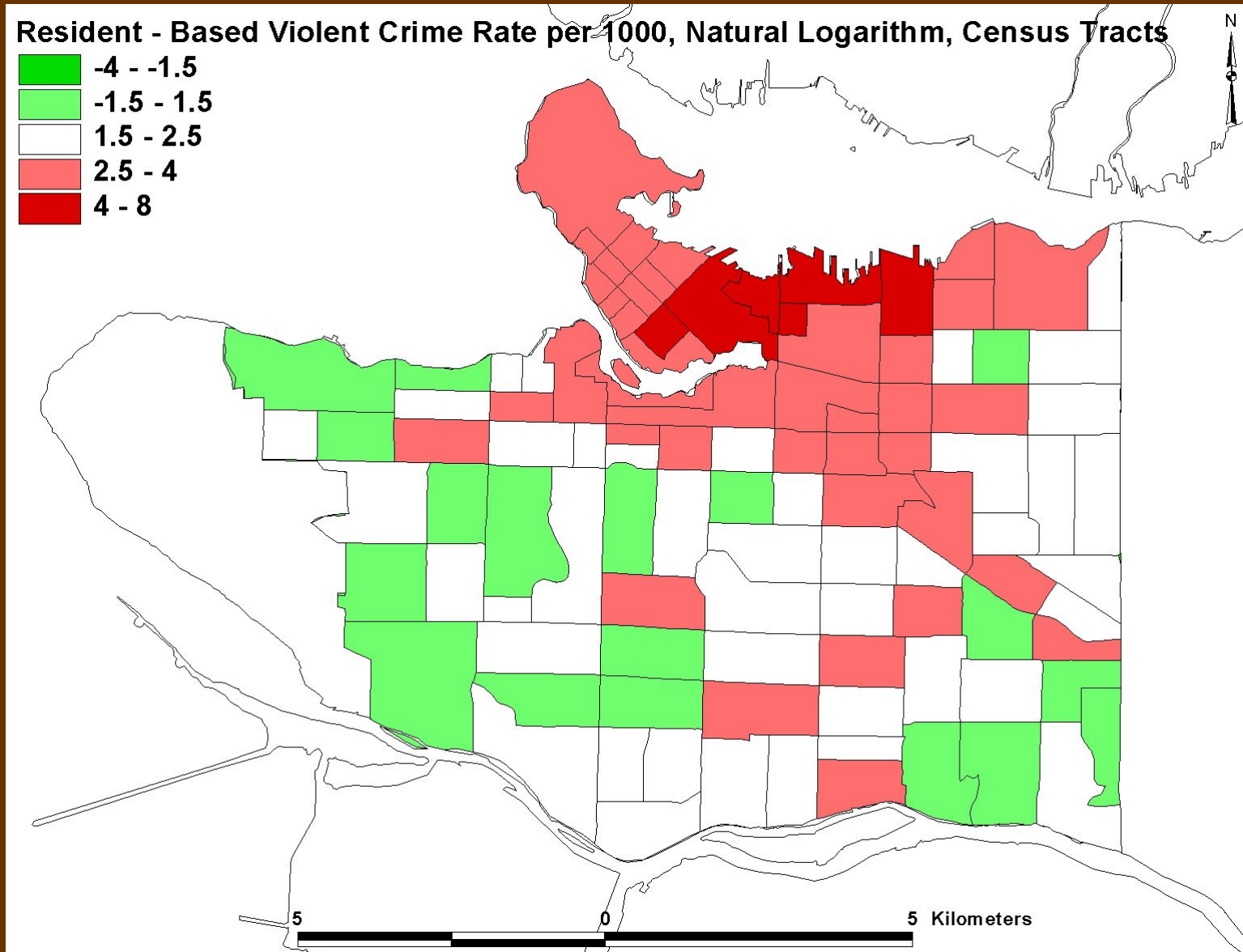
2001 Dissemination Areas



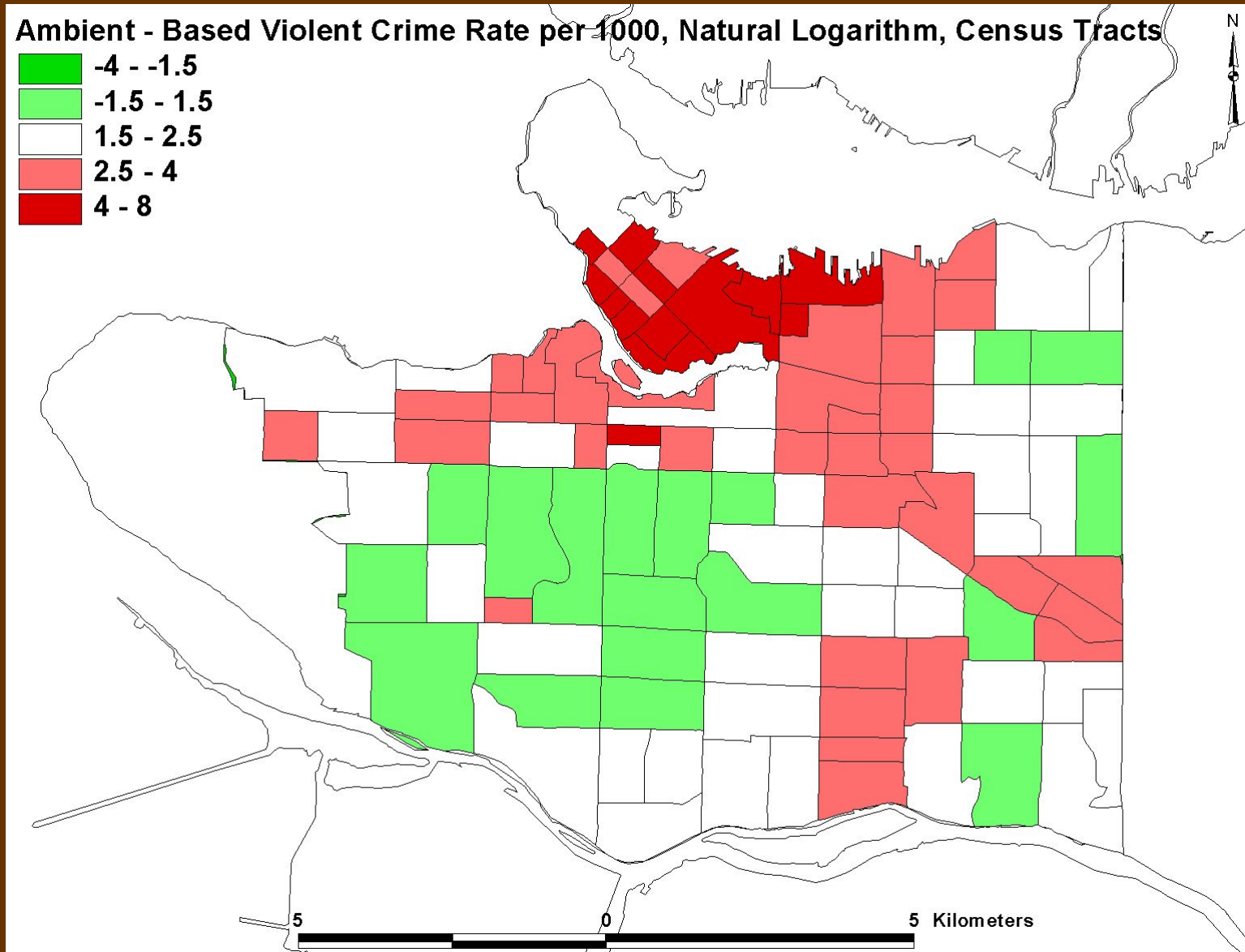
2001 Dissemination Areas



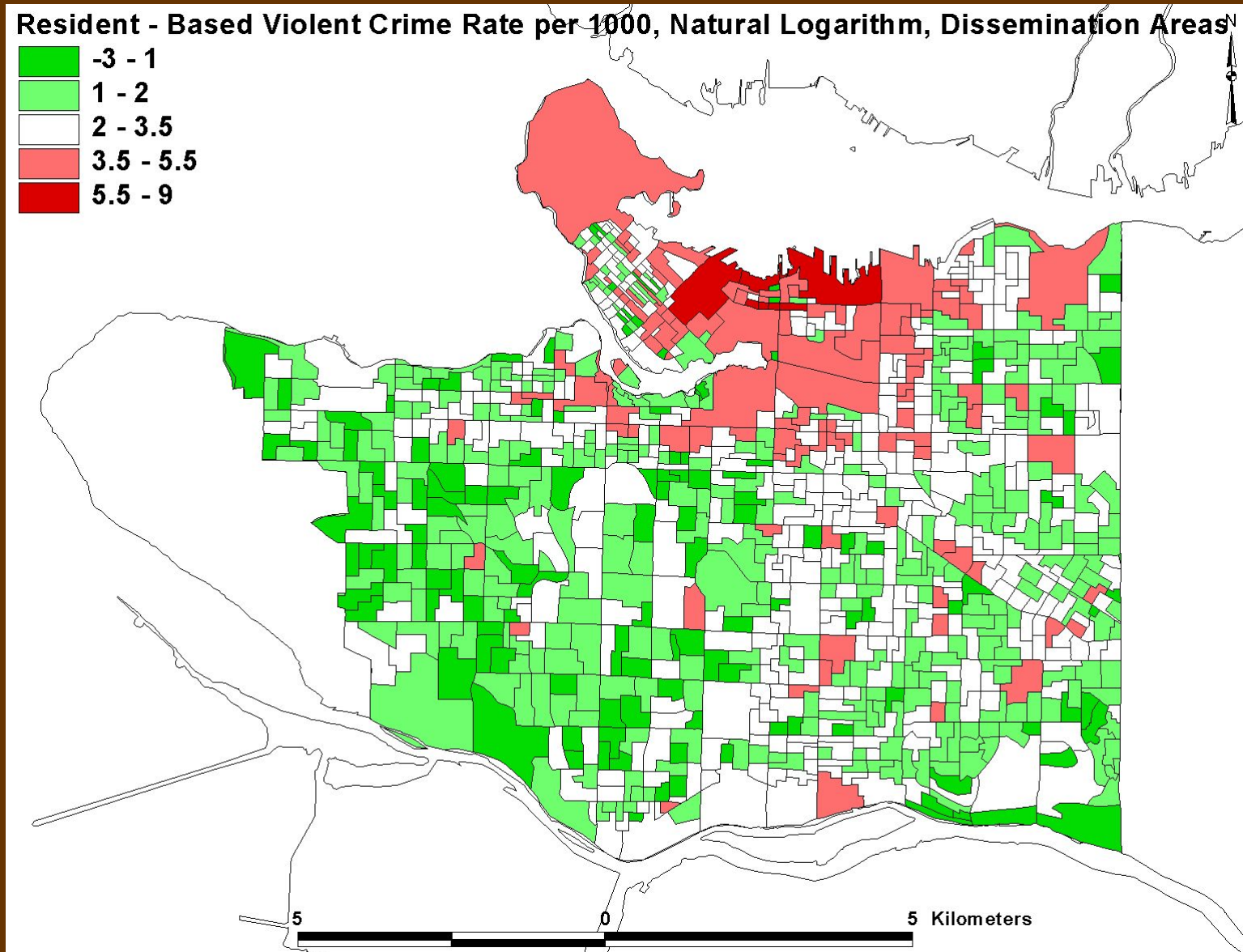
Resident – Based Violent Crime Rate



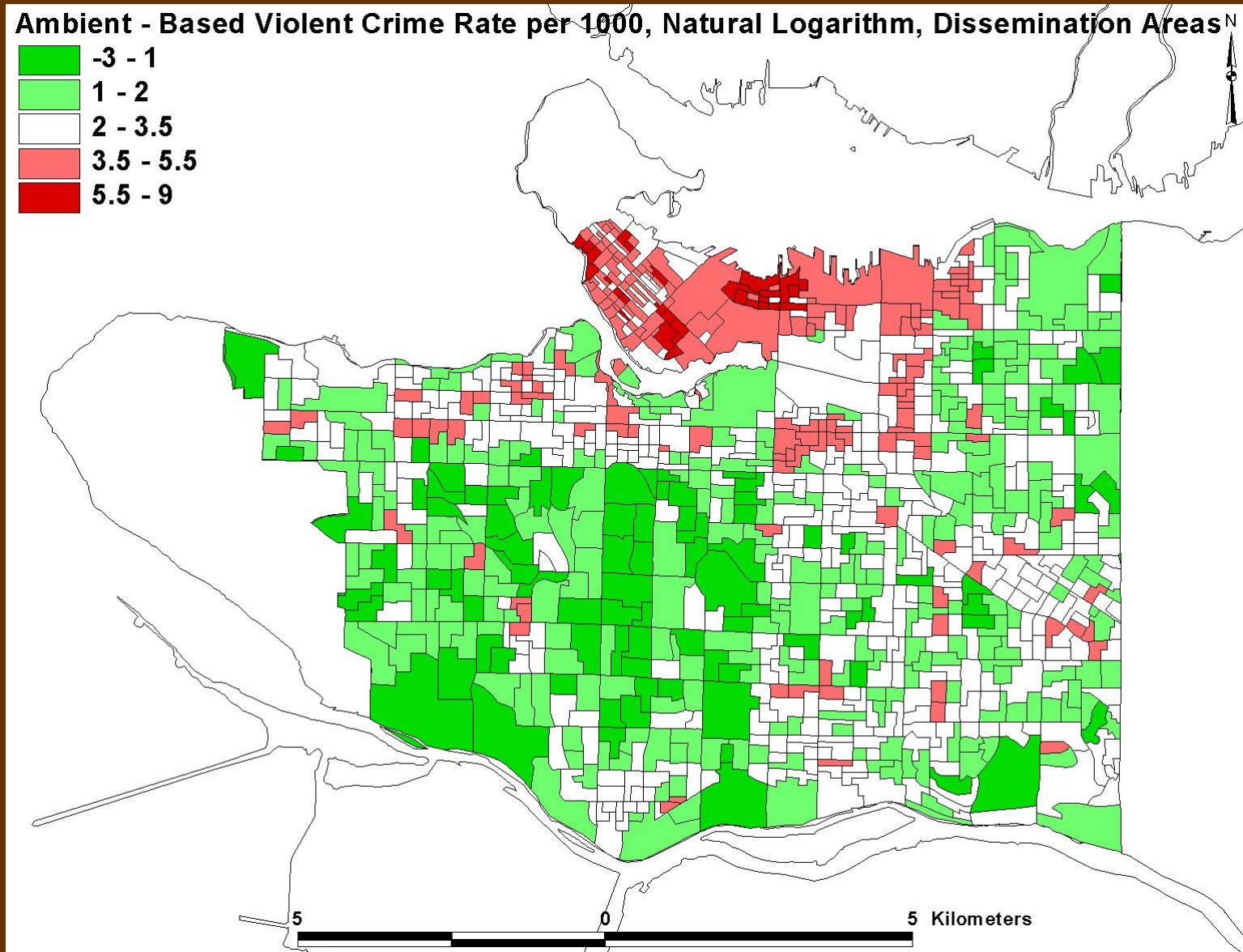
Ambient – Based Violent Crime Rate



Resident – Based Violent Crime Rate

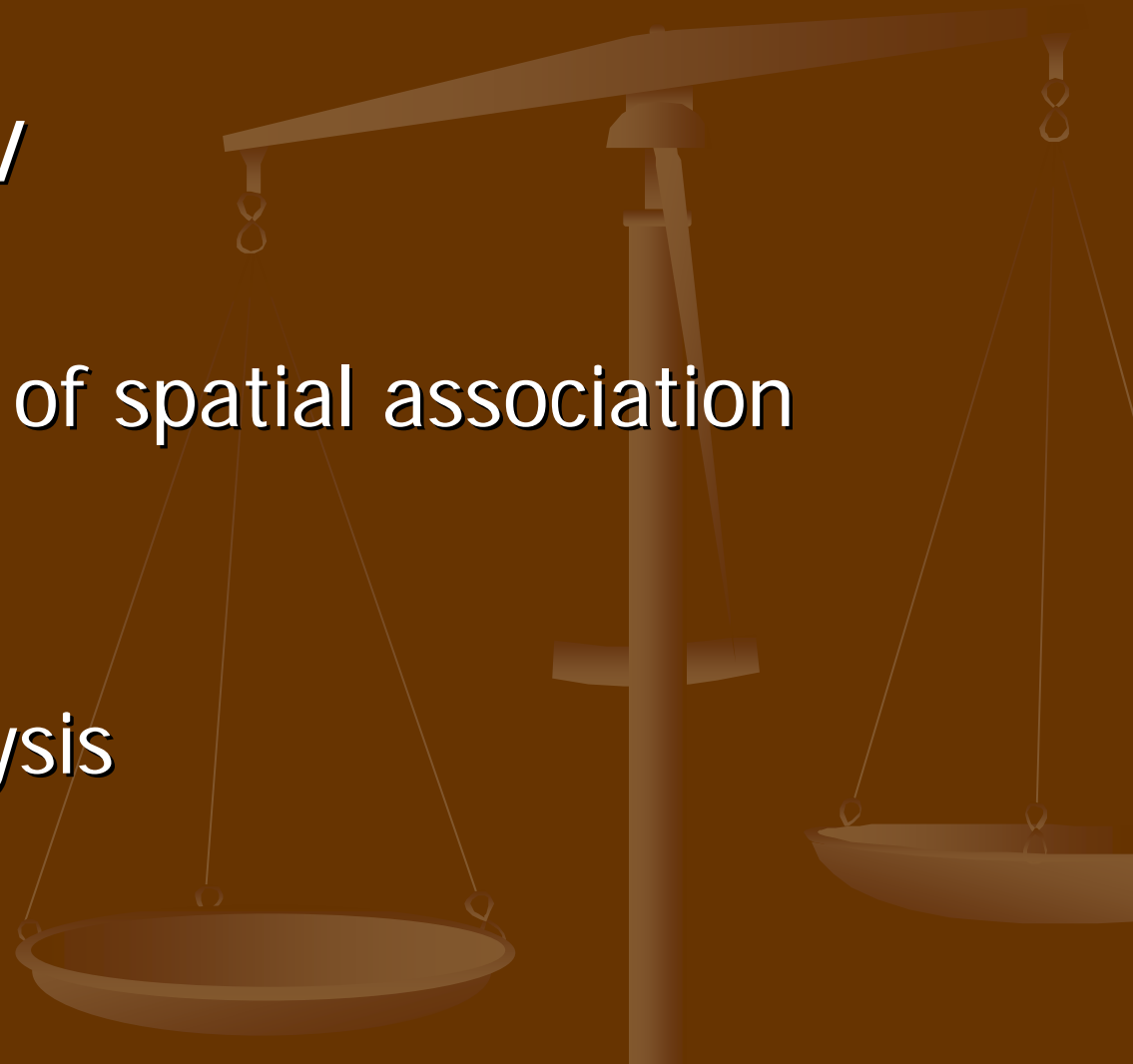


Ambient – Based Violent Crime Rate



How do the different populations and rates compare empirically?

- Global Moran's I
- Local indicators of spatial association (LISA)
- Inferential analysis



Global Moran's I

Table 1. Global Moran's I

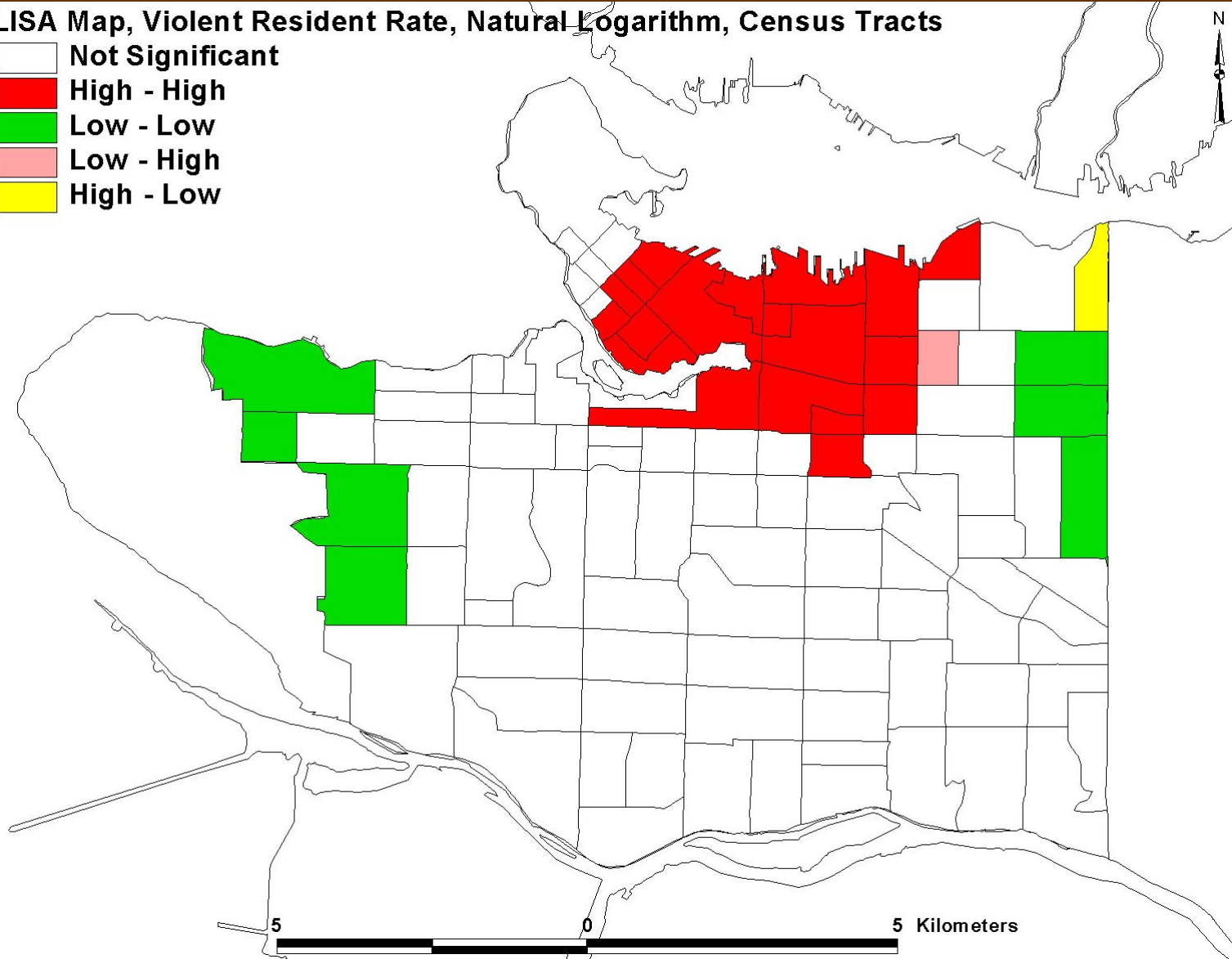
	CT	DA
Resident-based crime rate	0.489***	0.341***
Ambient-based crime rate	0.515***	0.567***
Residential population	0.001	0.164***
Ambient population	0.054*	0.211***

Notes. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$; crime rates are natural logarithms.

2001 Census Tracts

LISA Map, Violent Resident Rate, Natural Logarithm, Census Tracts

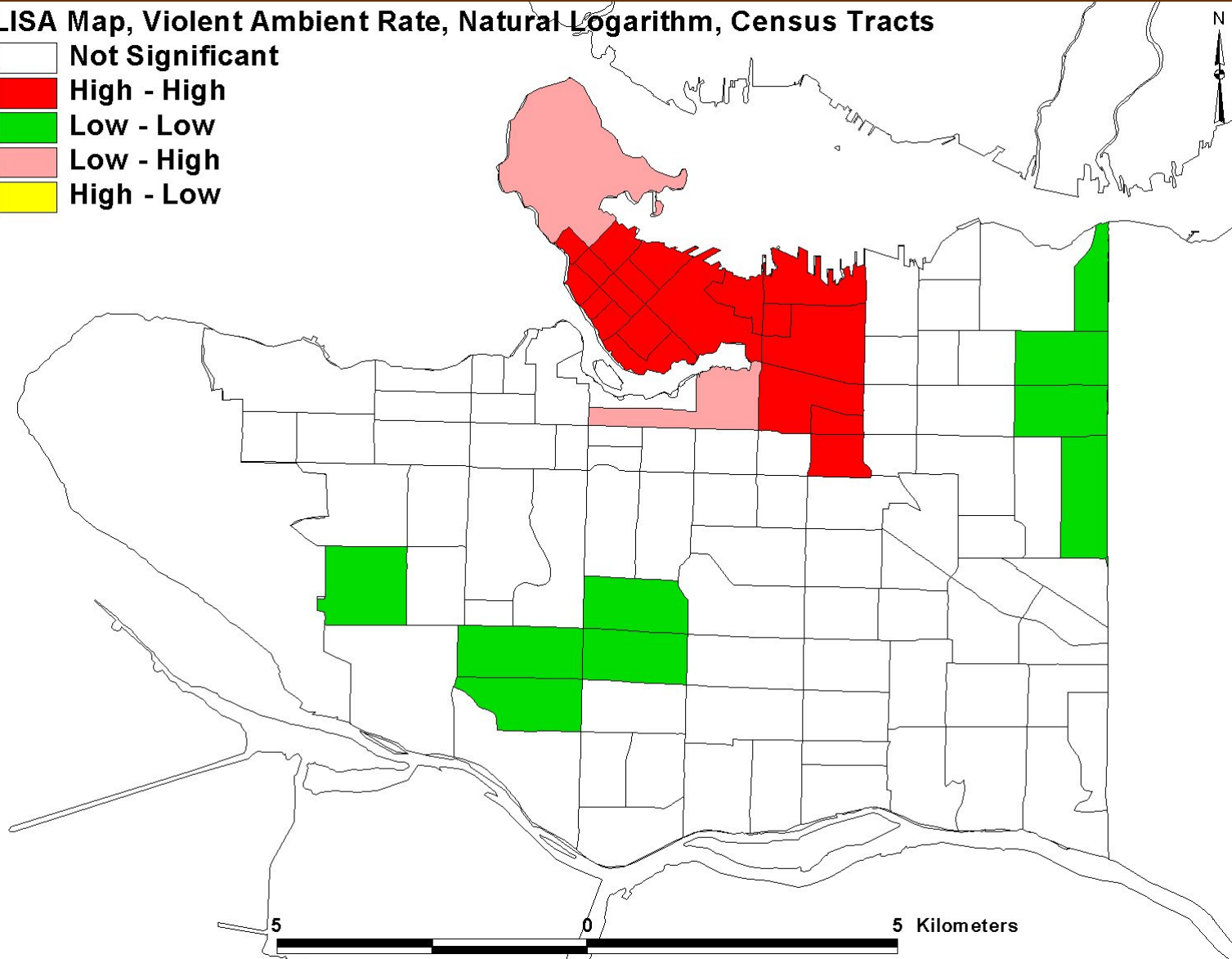
- Not Significant
- High - High
- Low - Low
- Low - High
- High - Low



2001 Census Tracts

LISA Map, Violent Ambient Rate, Natural Logarithm, Census Tracts

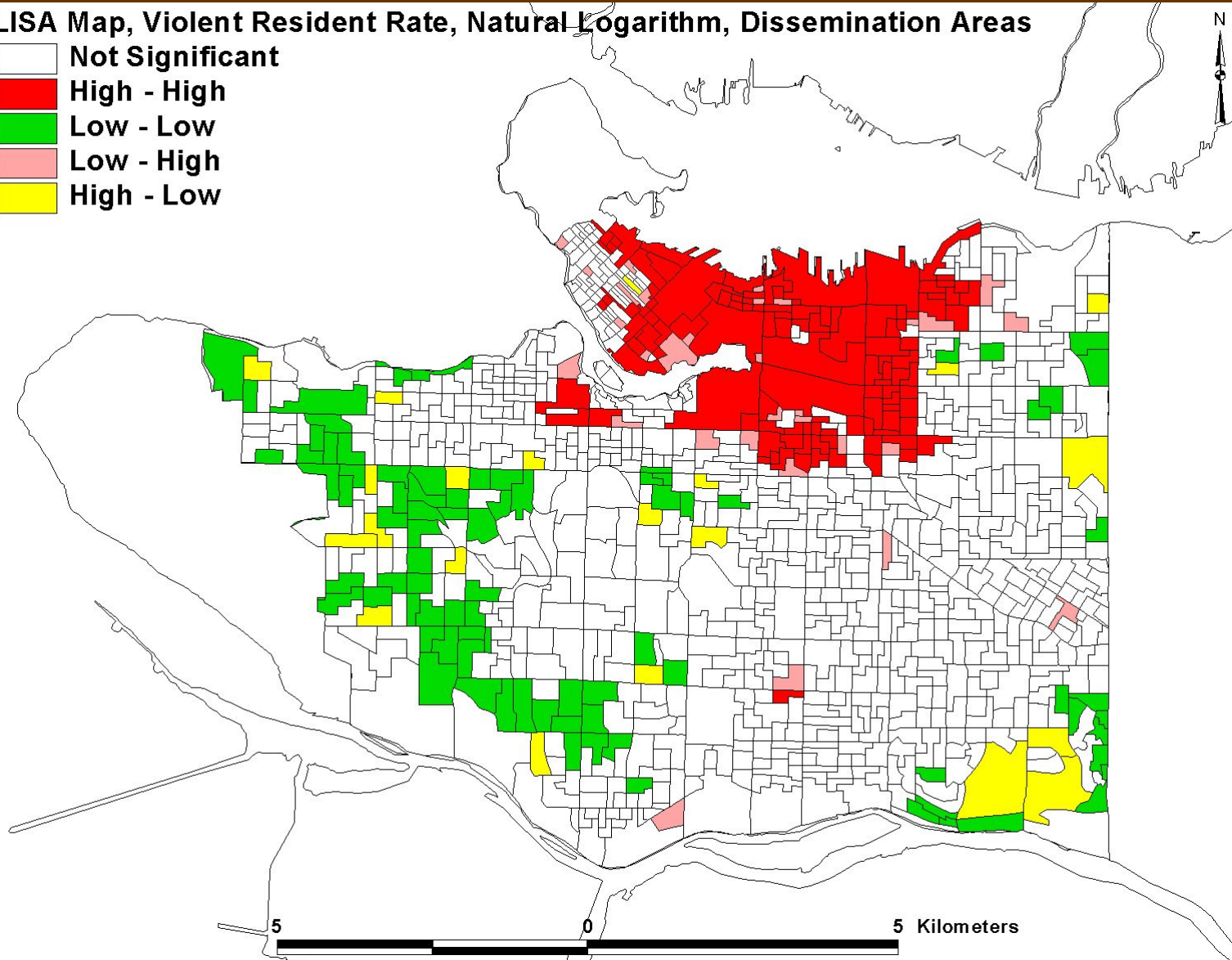
- Not Significant
- High - High
- Low - Low
- Low - High
- High - Low



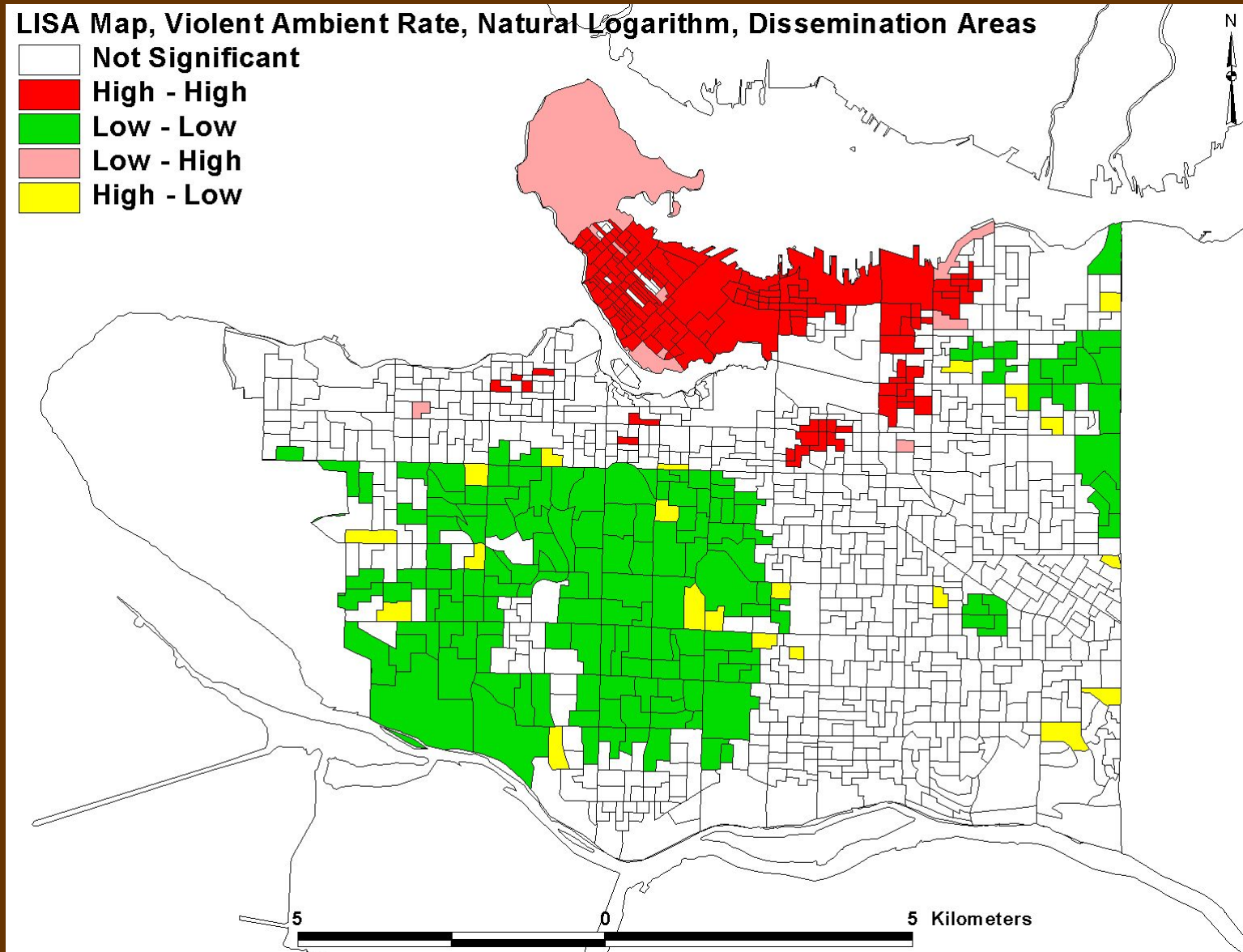
2001 Dissemination Areas

LISA Map, Violent Resident Rate, Natural Logarithm, Dissemination Areas

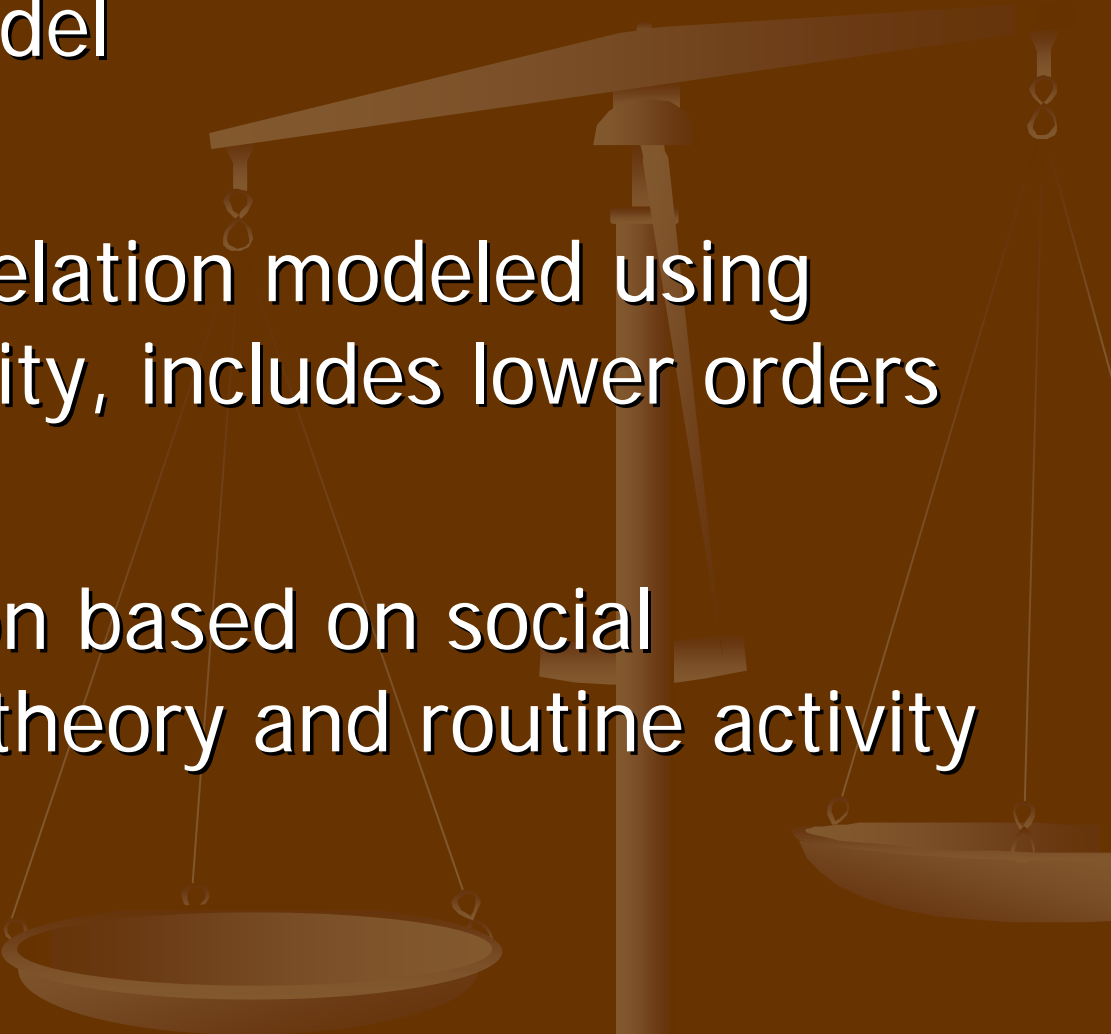
- Not Significant
- High - High
- Low - Low
- Low - High
- High - Low



2001 Dissemination Areas



Inferential analysis

- Spatial error model
 - Spatial autocorrelation modeled using Queen's contiguity, includes lower orders
 - Variable selection based on social disorganization theory and routine activity theory
- 

Spatial error model results

Table 2. Spatial error model results, census tracts

	Resident-based Violent Crime Rate	Ambient-based Violent Crime Rate
Resident population density	-2.52***	-1.47***
Ambient population	-0.89**	-0.87***
Ambient population density	1.03**	
Population turnover	0.75**	0.78***
Visible minorities	-0.43*	-0.44**
Ethnic heterogeneity	0.02*	0.02**
Post-secondary	-1.43***	-1.48***
Unemployment	0.51**	0.51***
Average family income	1.21*	1.29**
S.D. family income	-0.61**	-0.64***
Housing affordability	2.03**	2.03***
Dwelling density	1.31**	1.30**
Rentals	-0.95***	-0.94***
Pseudo - R^2	0.77	0.86
Spatial Dependence (LR)	0.99, p - value = 0.32	0.46, p - value = 0.50
Queen's Contiguity Order	5	6

Notes. All estimated coefficients are elasticities, except ethnic heterogeneity; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

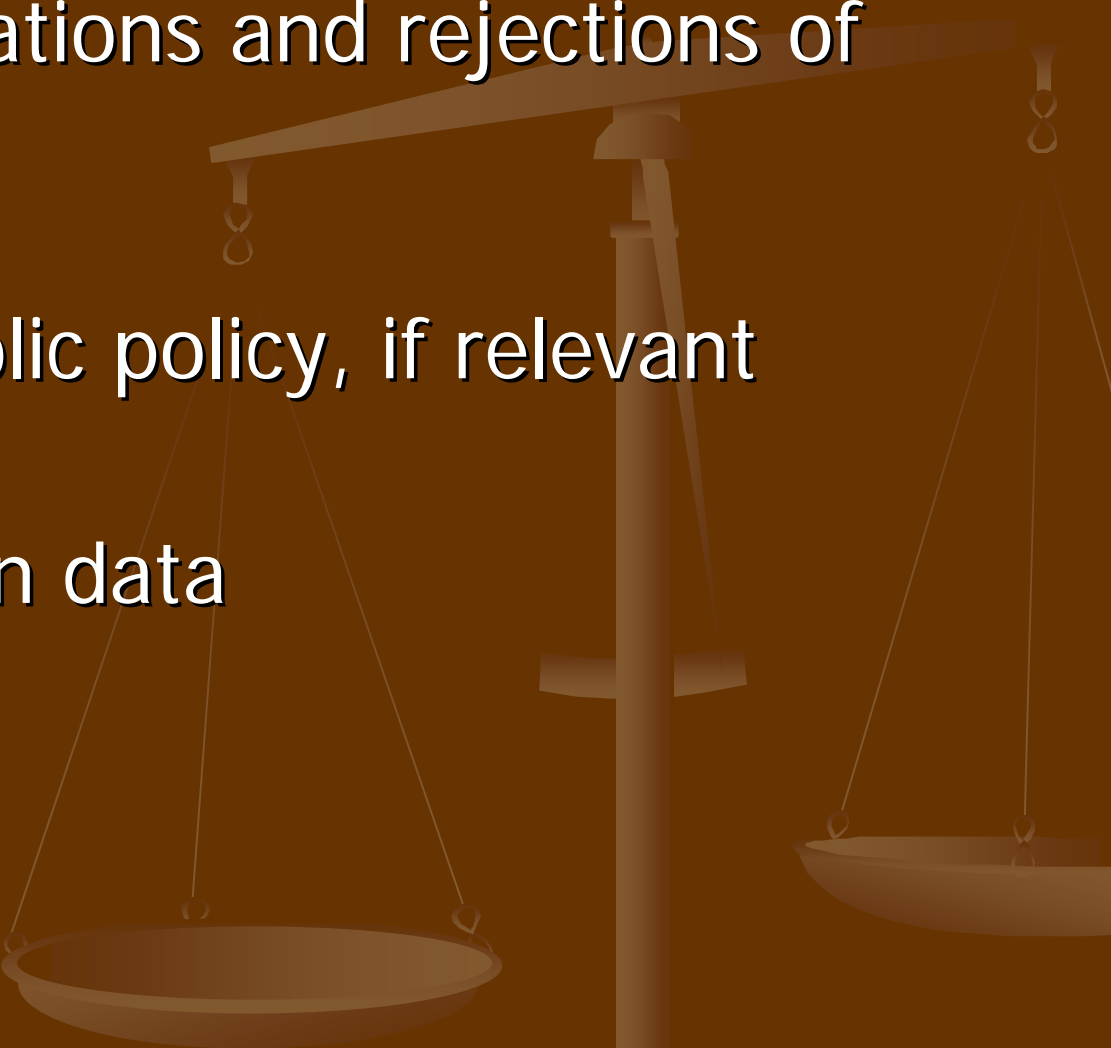
Spatial error model results

Table 3. Spatial error model results, dissemination areas

	Resident-based Violent Crime Rate	Ambient-based Violent Crime Rate
Resident population	1.28***	
Resident population density	-3.22***	-1.11***
Ambient population		-1.52***
Ambient population density		0.64***
Population turnover		0.08*
Never married	1.32***	1.16***
Ethnic heterogeneity		0.01*
Ehet * Immigrants	0.01**	0.01*
Post-secondary	-0.60***	-0.65***
Unemployment	0.05*	0.07**
Average family income	-0.29**	-0.32**
Low income		-0.13*
Housing affordability		0.17*
Average dwelling value	-0.26**	-0.35***
Number of dwellings	2.74***	2.74***
Occupancy rate	-2.38***	-2.23***
Apartments	0.15***	0.10***
Pseudo - R^2	0.38	0.58
Spatial Dependence (LR)	0.72, p - value = 0.32	3.64, p - value = 0.06
Queen's Contiguity Order	13	10

Notes. All estimated coefficients are elasticities, except ethnic heterogeneity and Ehet * Immigrants; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

Directions for future research

- Re-visit confirmations and rejections of theories
 - Re-evaluate public policy, if relevant
 - Higher resolution data
 - Temporal data
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