Applying a Spatial Perspective to the Study of Violence: Lessons Learned

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Lessons learned:

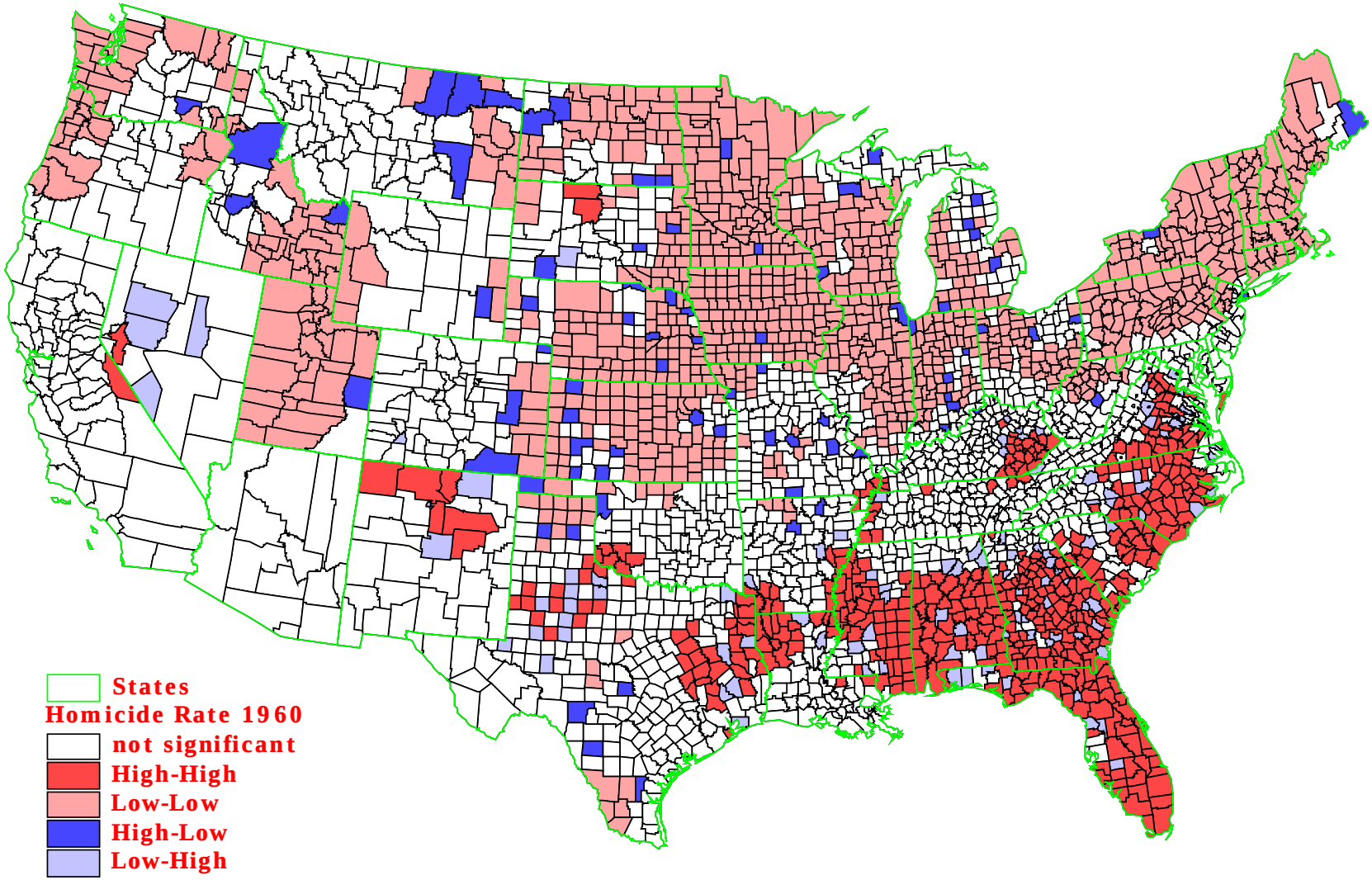
1. Spatial effect measures are really just proxies for unobserved processes.

2. Behavioral units-of-analysis should be used before strong diffusion claims are made.

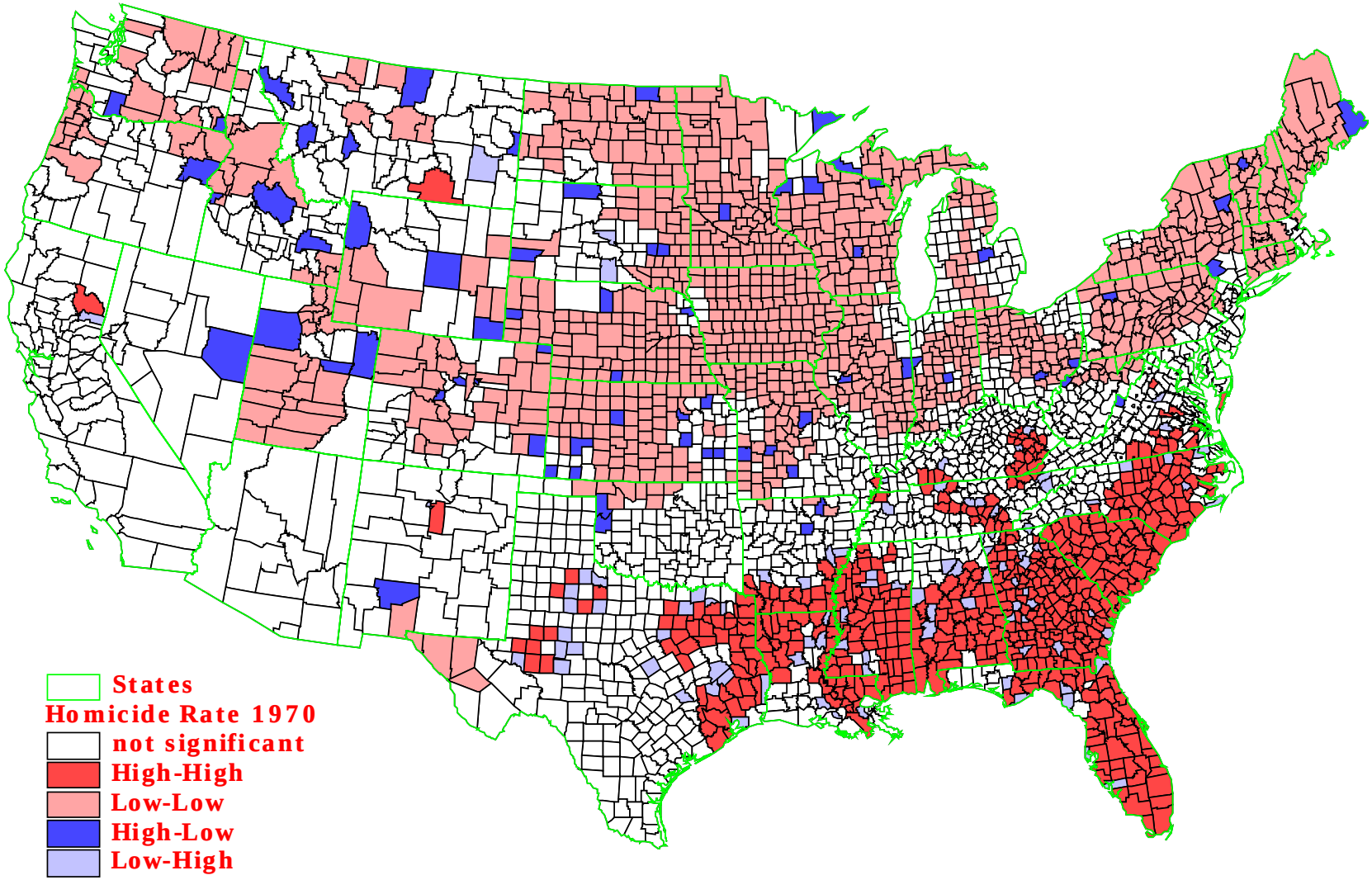
3. Spatial analysis is clearly valuable for alleviating some sources of estimate bias and inefficiency.

4. The spatial perspective can be used to illustrate some fundamental methodological issues like inductive research, measure interchangeability, model elaboration, and triangulation.

Map 1. Moran Scatterplot Map (W=10 Nearest Neighbors)
Homicide Rate 1960



Map 2. Moran Scatterplot Map (W=10 Nearest Neighbors)
Homicide Rate 1970



Map 3. Moran Scatterplot Map (W=10 Nearest Neighbors)
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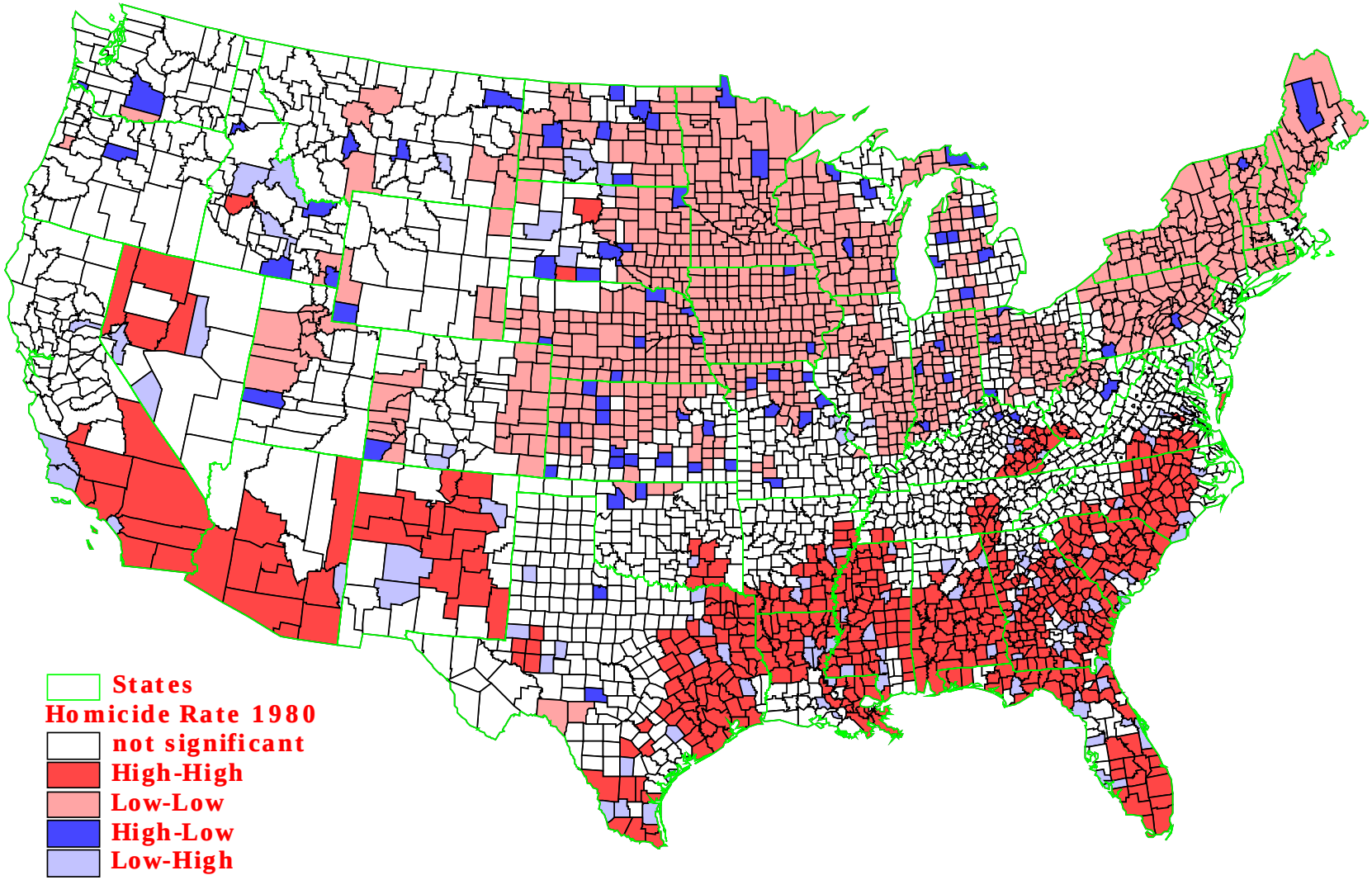
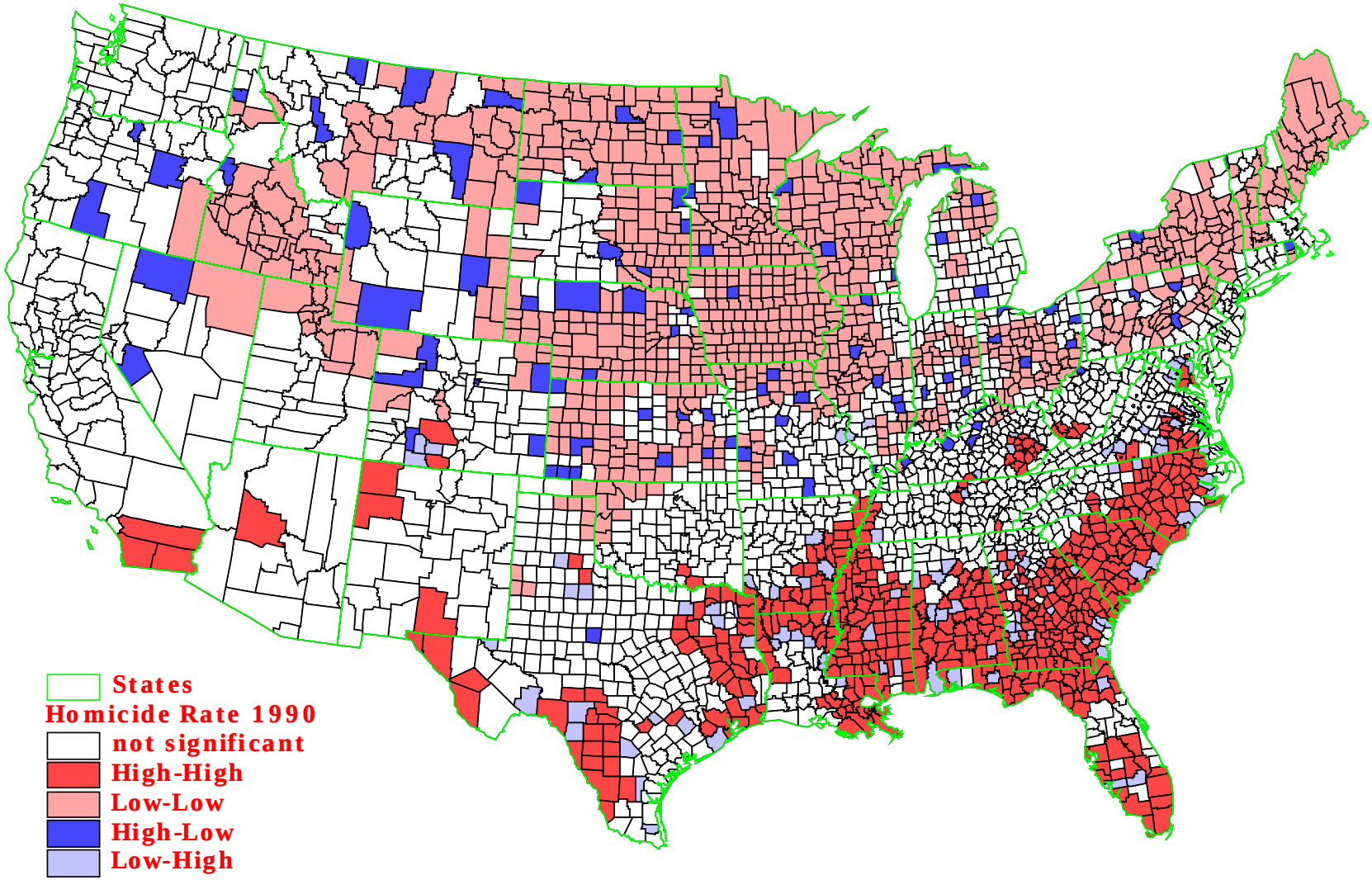
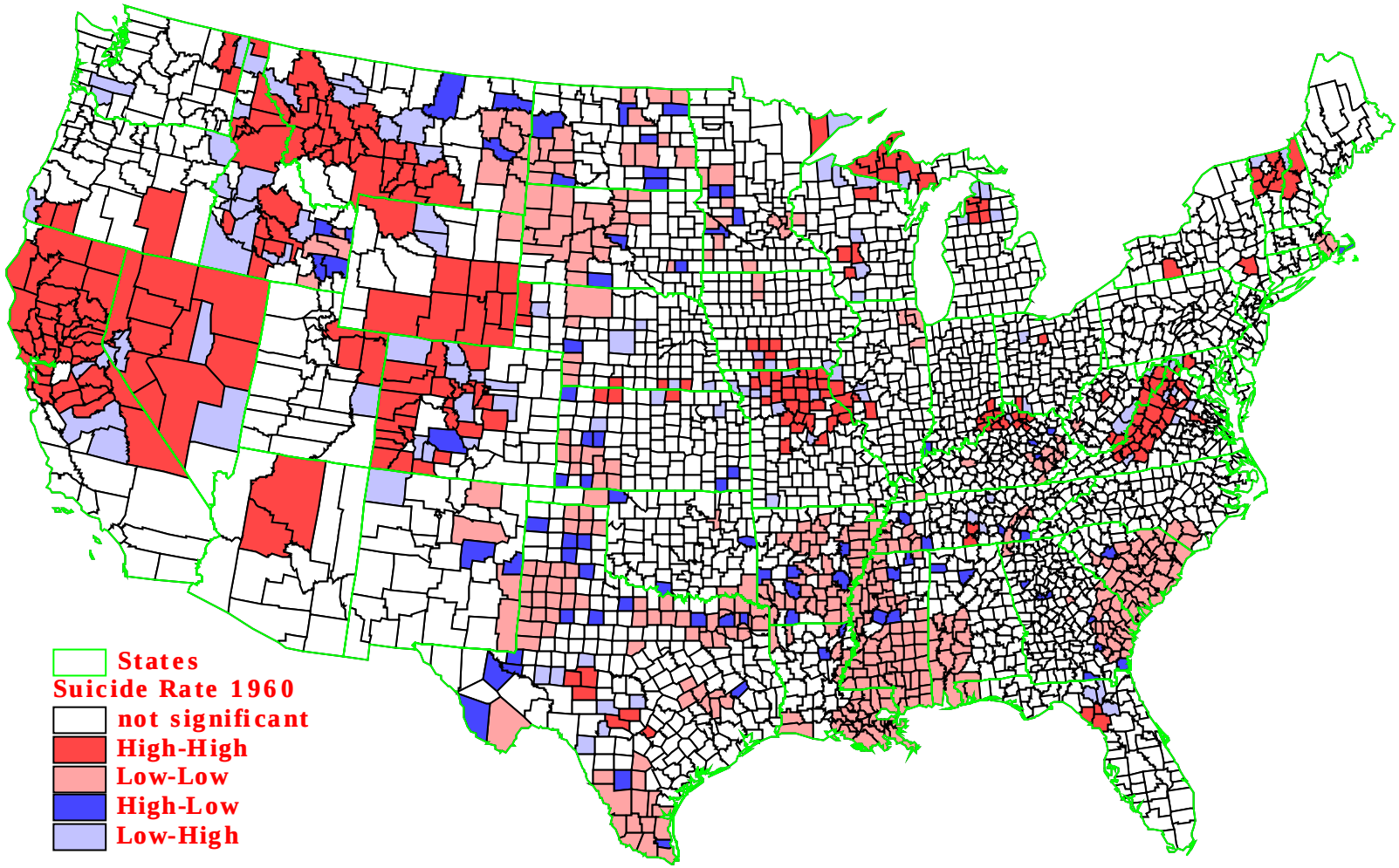


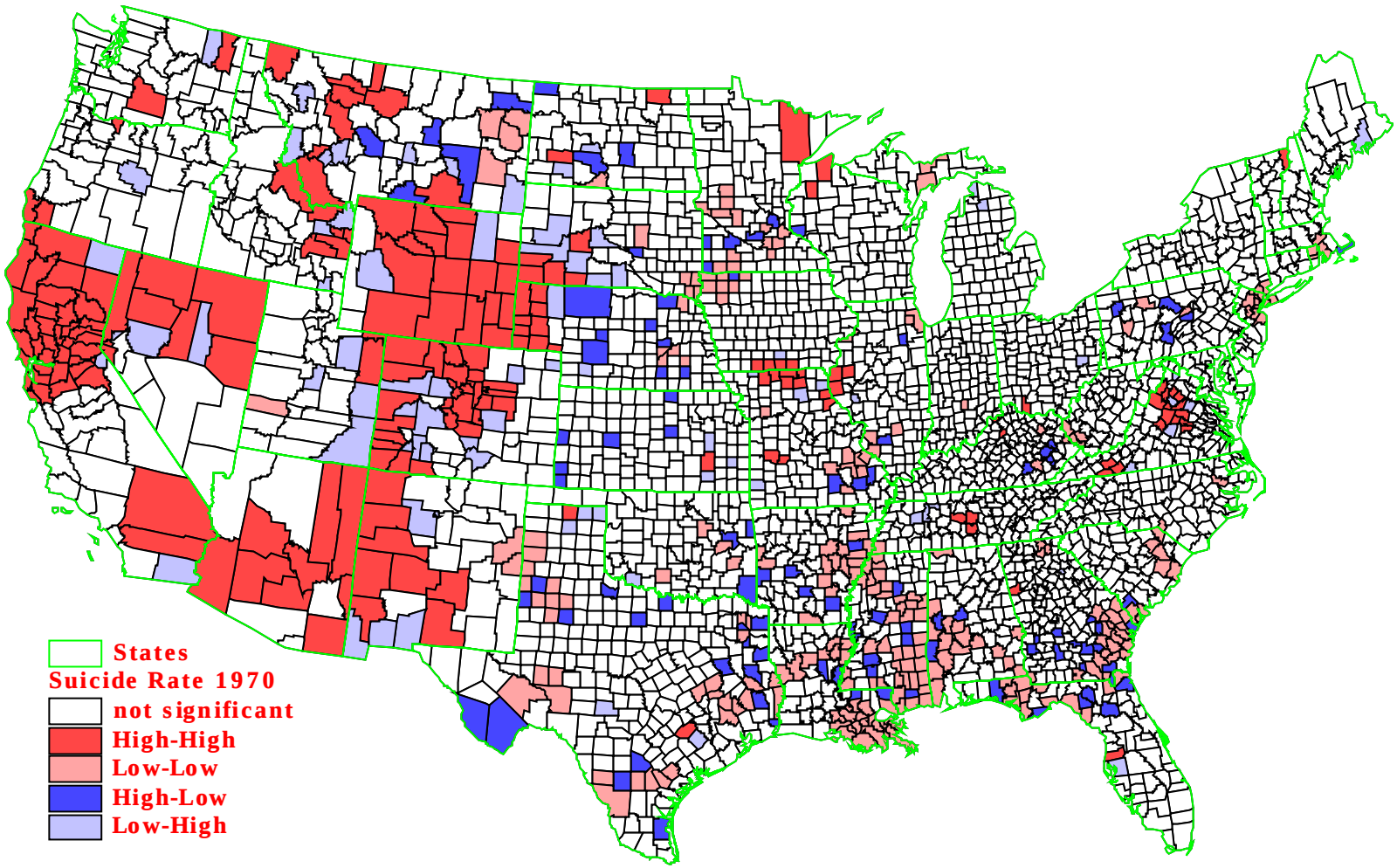
Map 4. Moran Scatterplot Map (W=10 Nearest Neighbors)
Homicide Rate 1990



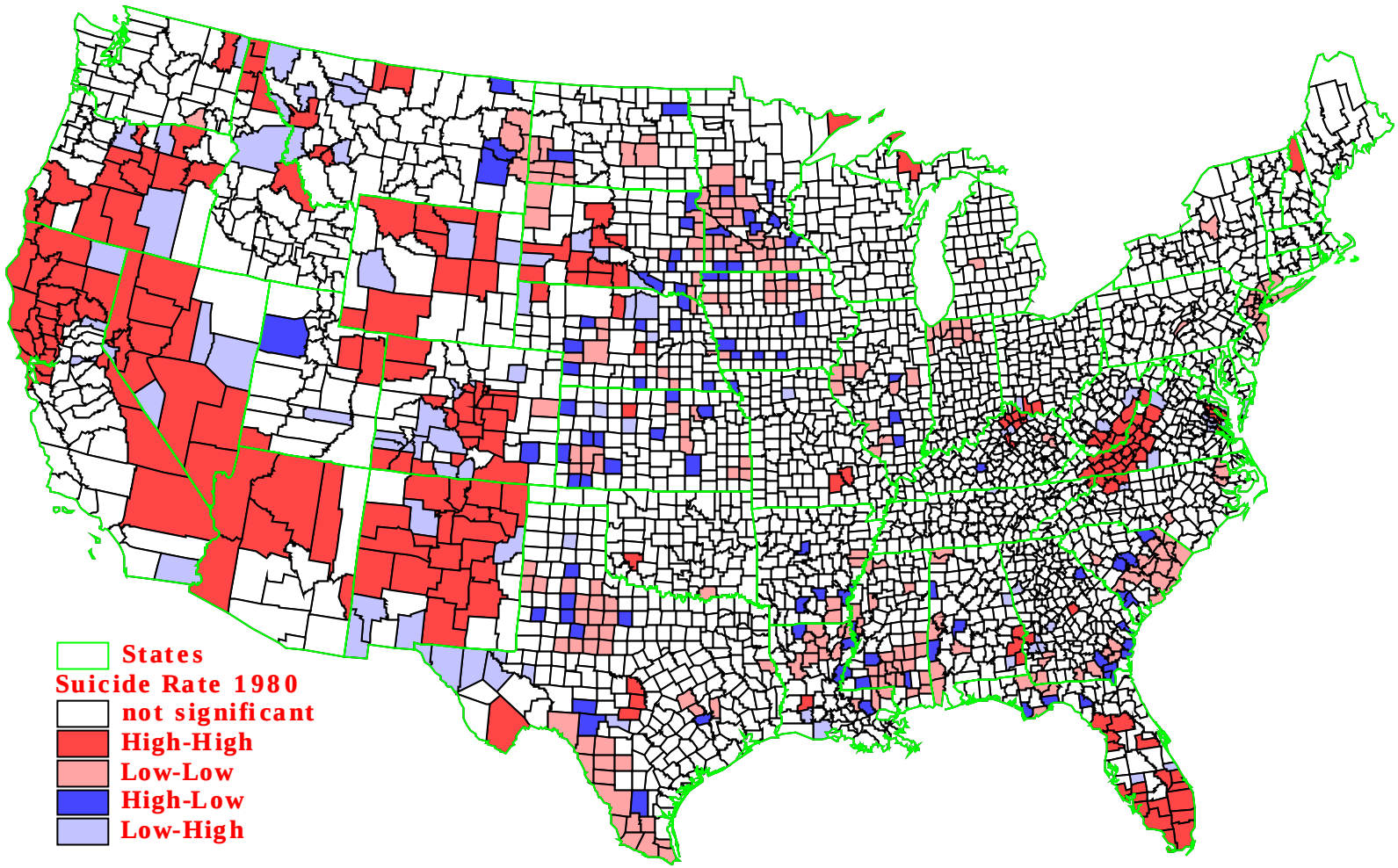
Map 5. Moran Scatterplot Map (W=10 Nearest Neighbors)
Suicide Rate 1960



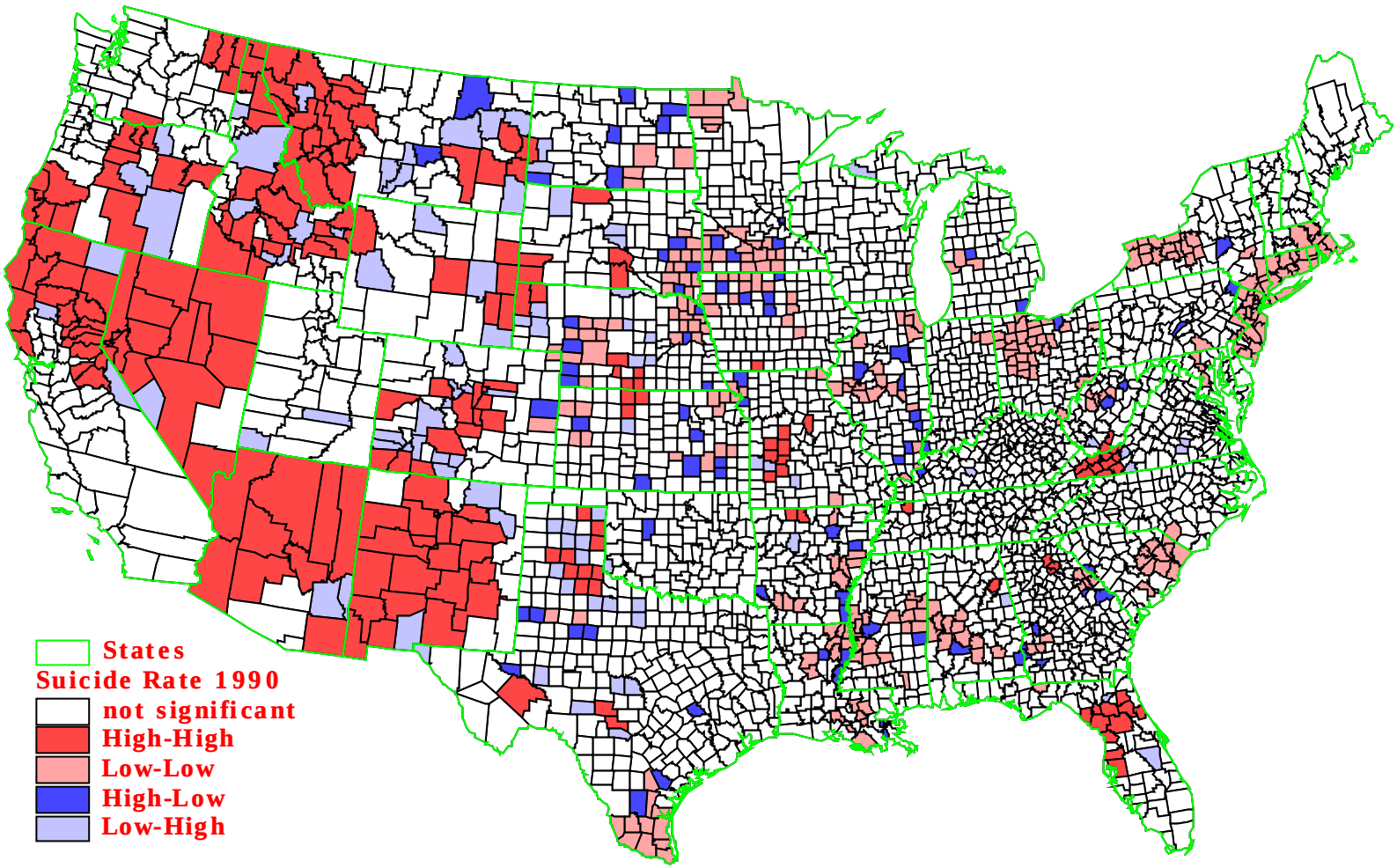
Map 6. Moran Scatterplot Map (W=10 Nearest Neighbors)
Suicide Rate 1970



Map 7. Moran Scatterplot Map (W=10 Nearest Neighbors)
Suicide Rate 1980



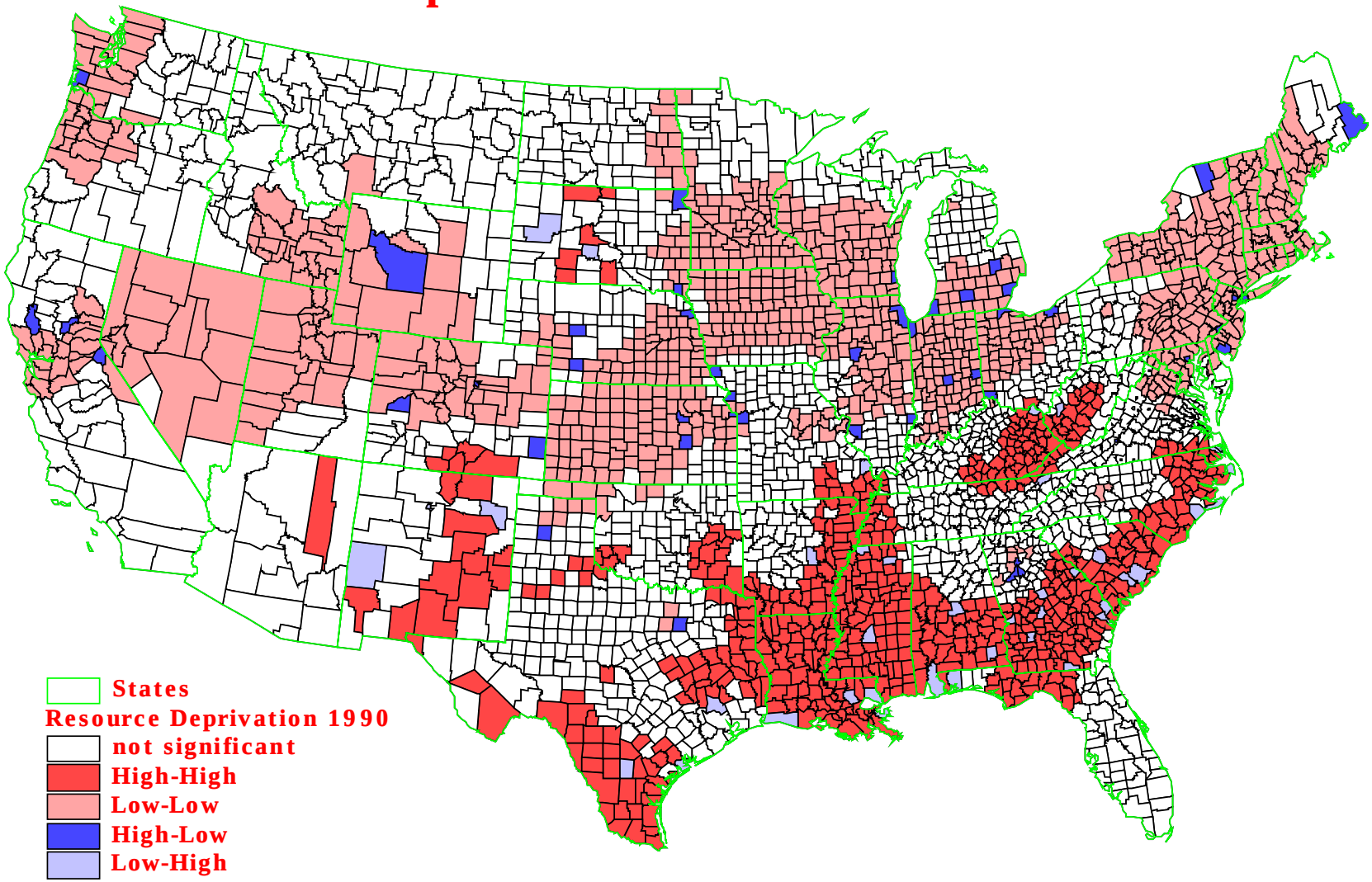
Map 8. Moran Scatterplot Map (W=10 Nearest Neighbors)
Suicide Rate 1990



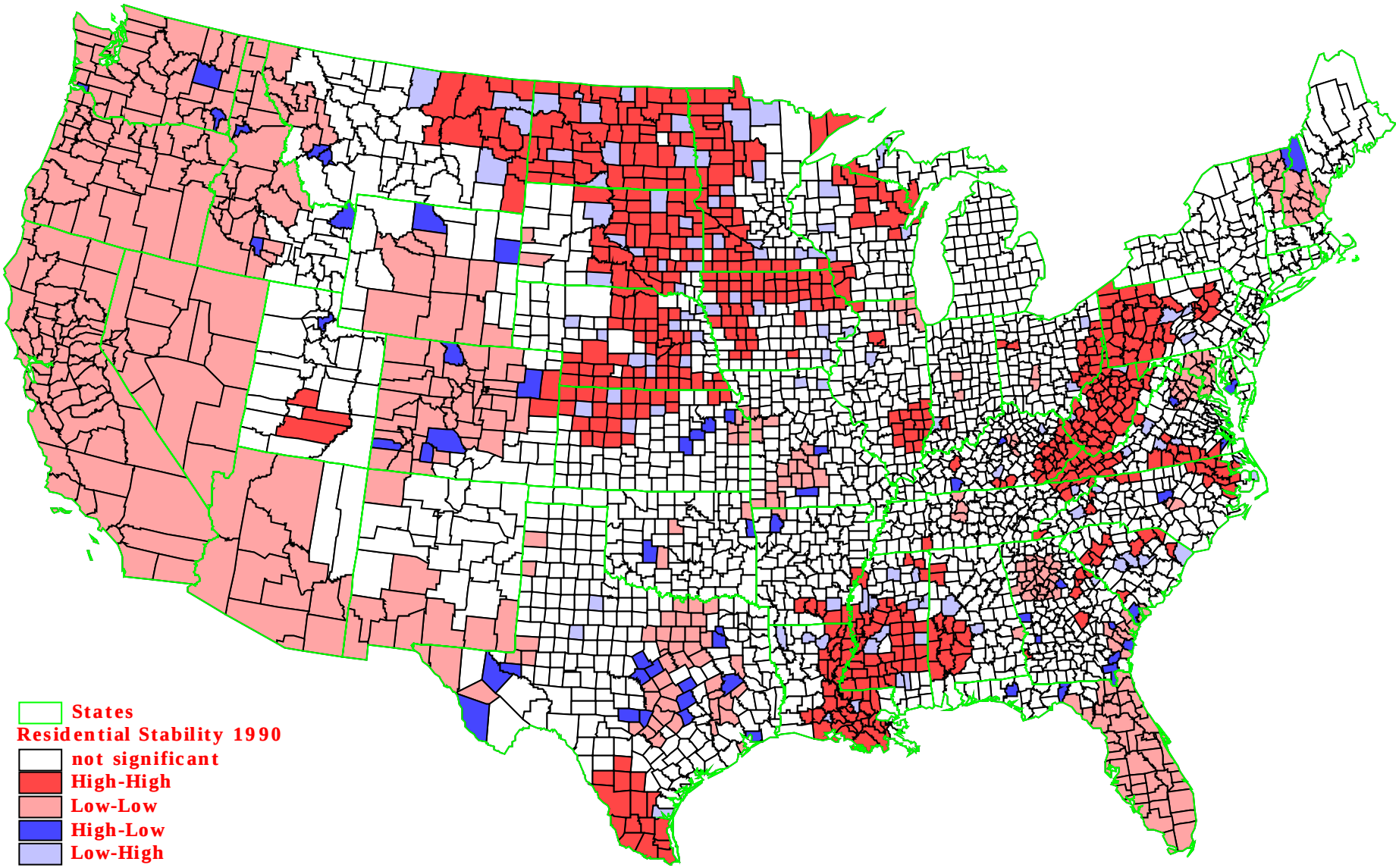
Why do rates of violence cluster in geographic space?

1. The important structural predictors of violence cluster in space.

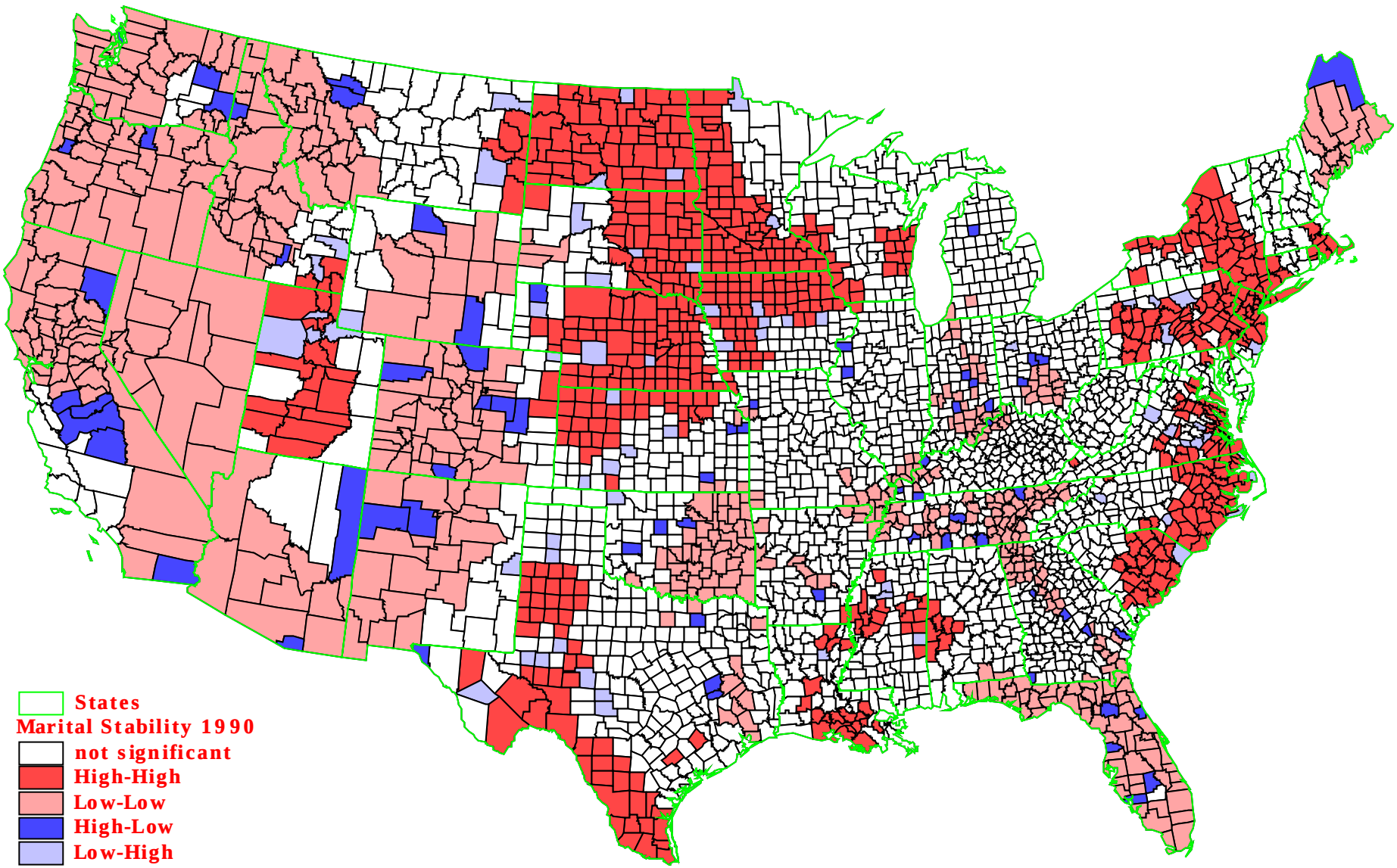
Map 9. Moran Scatterplot Map (W=10 Nearest Neighbors)
Resource Deprivaton 1990



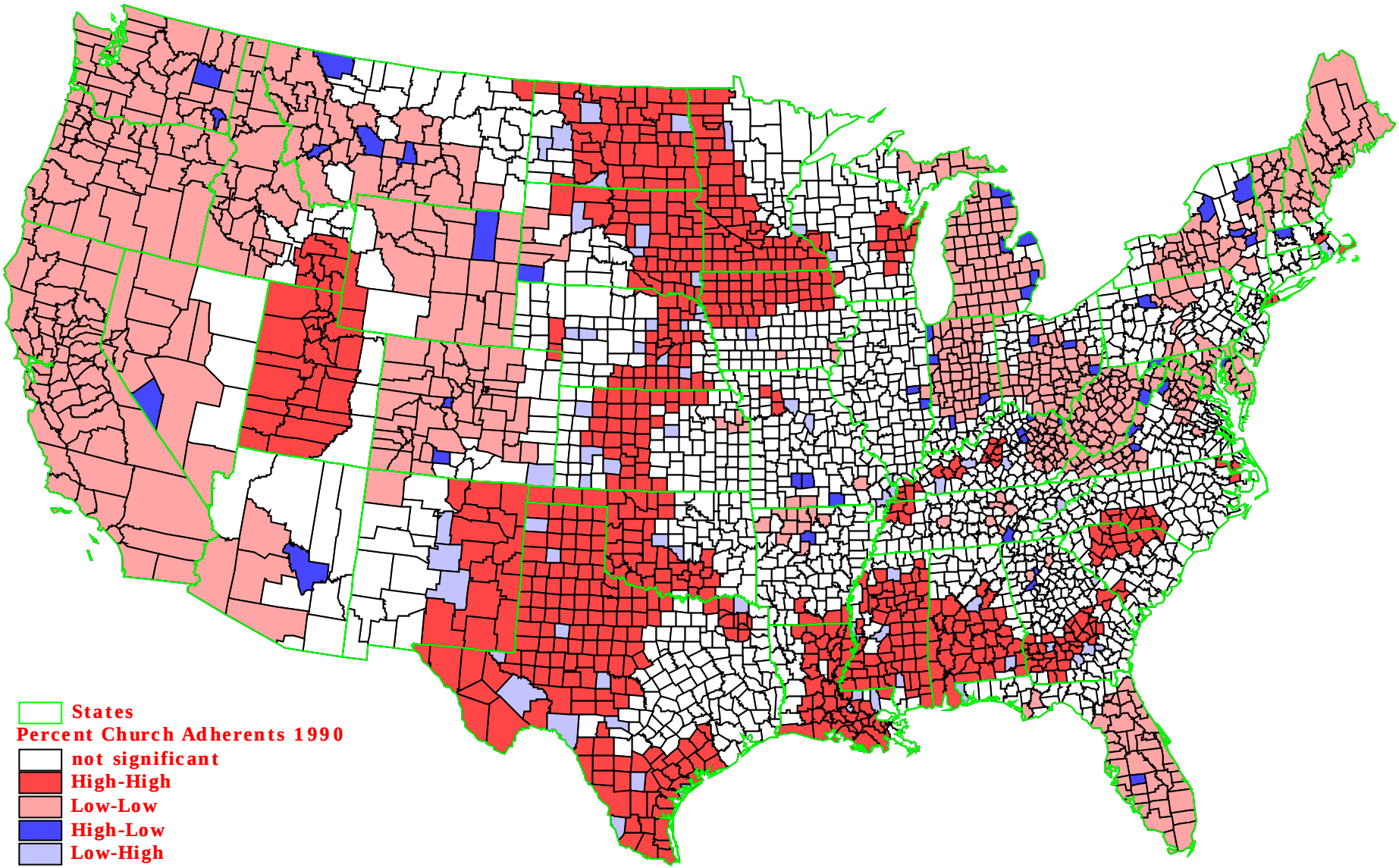
Map 10. Moran Scatterplot Map (W=10 Nearest Neighbors)
Residential Stability 1990



Map 11. Moran Scatterplot Map (W=10 Nearest Neighbors)
Marital Stability 1990



Map 12. Moran Scatterplot Map (W=10 Nearest Neighbors)
Percent Church Adherents 1990



Visual inspections of maps can only take us so far.

Multivariate spatial regression models allow us to determine if the clustering in violence is really driven by the clustering of measured social structural independent variables.

Spatial Error Model: $y = X\beta + \varepsilon$, where $\varepsilon = \lambda W\varepsilon + u$

Spatial Lag Model: $y = \rho Wy + X\beta + u$

Table 1. Spatial Lag Models of Southern Homicide Rates 1960-1990[a]

Independent Variables	1960	1970	1980	1990
Resource Dep/Aff Comp.	0.832**	1.792**	3.026**	4.028**
Pop. Struct. Comp.	-0.057	0.401	1.551**	1.747**
Median Age	-0.129**	-0.060	-0.150**	-0.018
Divorce	0.786**	0.642**	0.775**	0.482**
Unemployment	-0.070	-0.353**	-0.244**	-0.438**
Spatial Lag (ρ)	0.713**	0.651**	0.182*	0.230**
Intercept	4.108*	4.153*	9.101**	5.249*
Sq. Corr.	0.178	0.239	0.311	0.333
N	1412	1412	1412	1412

Notes:
[a] Unstandardized regression coefficients.
** $P \leq .01$ * $P \leq .05$ (two-tailed tests).

From Baller, Anselin, Messner, Deane, and Hawkins, 2001 Criminology

Table 2. Spatial Regression Models of Nonsouthern Homicide Rates[a]

Independent Variables	1960	1970	1980	1990
Resource Dep/Aff Comp.	1.571**	3.007**	4.143**	2.875**
Pop. Struct. Comp.	0.386**	0.859**	0.290*	0.962**
Median Age	-0.156**	-0.157**	-0.304**	-0.066*
Divorce	0.833**	1.403**	1.318**	0.572**
Unemployment	0.079**	-0.024	0.008	-0.045
Spatial Lag (ρ)	0.415**	NI	NI	NI
Spatial Error (λ)	NI	0.243	0.329	0.268
Intercept	4.832**	6.164**	9.622**	3.261**
Sq. Corr.	0.199	0.234	0.348	0.258
N	1673	1673	1673	1673

Notes:
[a] Unstandardized regression coefficients.
** P ≤ .01 * P ≤ .05 (two-tailed tests).

From Baller, Anselin, Messner, Deane, and Hawkins, 2001 Criminology

Table 3. Spatial Regressions of 1989 1991 U.S. County Suicide Rates: Western and Nonwestern Counties

	West[a]	non-West
Residential Stability	- 189*	- 019
	(.099)	(.025)
	[-.150]	[-.022]
Marital Stability	-.701*	-.574***
	(.353)	(.099)
	[-.130]	[-.136]
Percent Church Adherents	.041	-.004
	(.046)	(.009)
	[.074]	[-.011]
Percent Catholic	-.098*	-.001
	(.050)	(.011)
	[.111]	[.002]
Religious Homogeneity	10.957***	2.556**
	(3 357)	(1 090)
	[.218]	[.051]
Spatial Lag (ρ)	N.A.	.299*
		(.139)
		[.063]
Spatial Error (λ)[b]	.113	N.A.
N	409	2651
Sq. Corr.	.160	.098

From Baller and Richardson, 2002 American Sociological Review

Why do rates of violence cluster in geographic space?

1. The important structural predictors of violence cluster in space.

2. Diffusion: violence may spread like an infectious disease.

What is spatial about violence?

1. Spatial analysis is potentially valuable for substantive reasons

    -The clustering of measured independent variables, unmeasured independent variables, or diffusion may explain why violence clusters in space.

2. Spatial analysis is valuable for statistical reasons

    -Estimate bias and inefficiency

Units-of-analysis should be behavioral before strong claims about diffusion are made.

Basic methodological issues that can be examined/illustrated using spatial analysis:

Inductive research

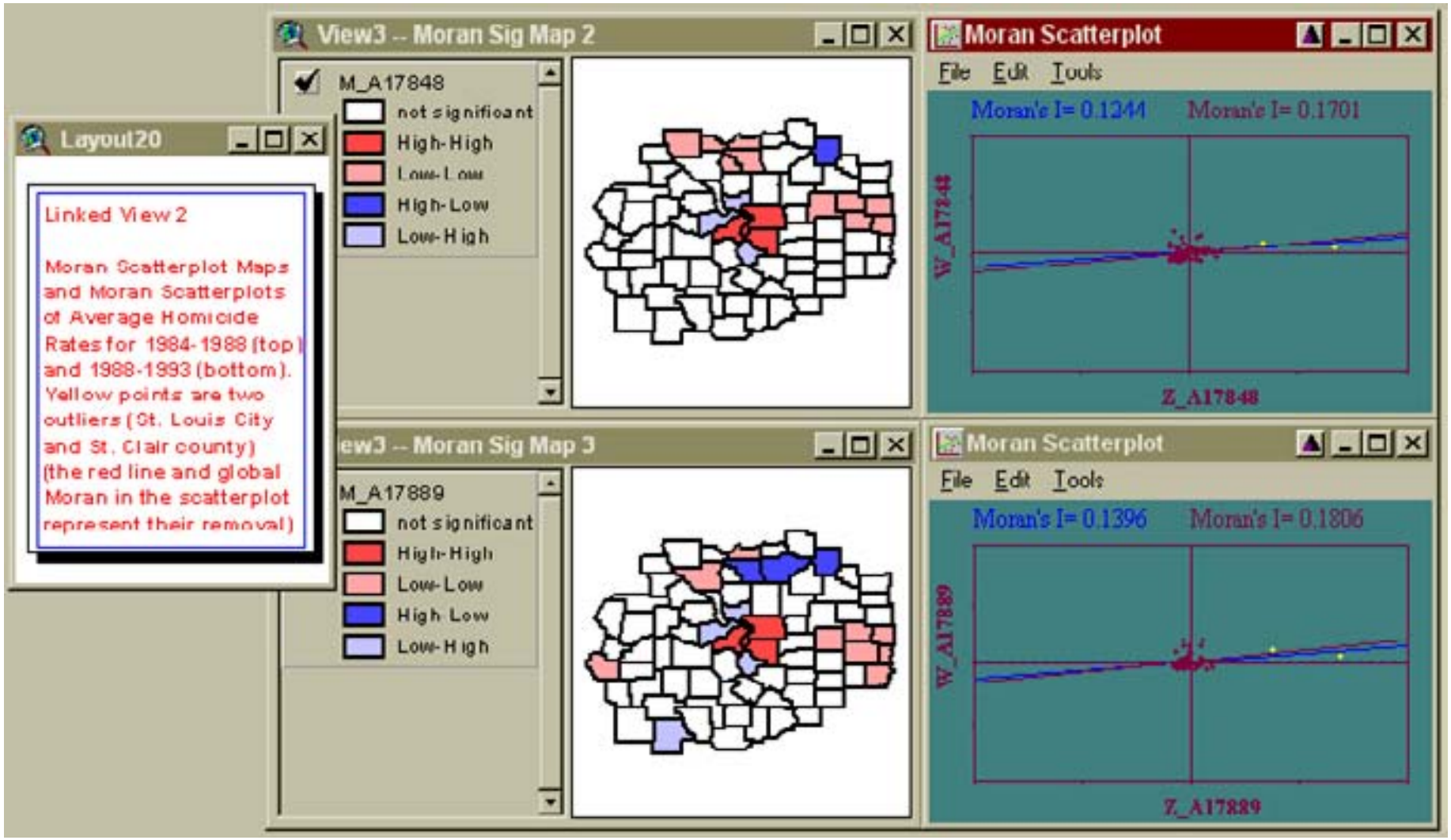
Interchangeability of measures

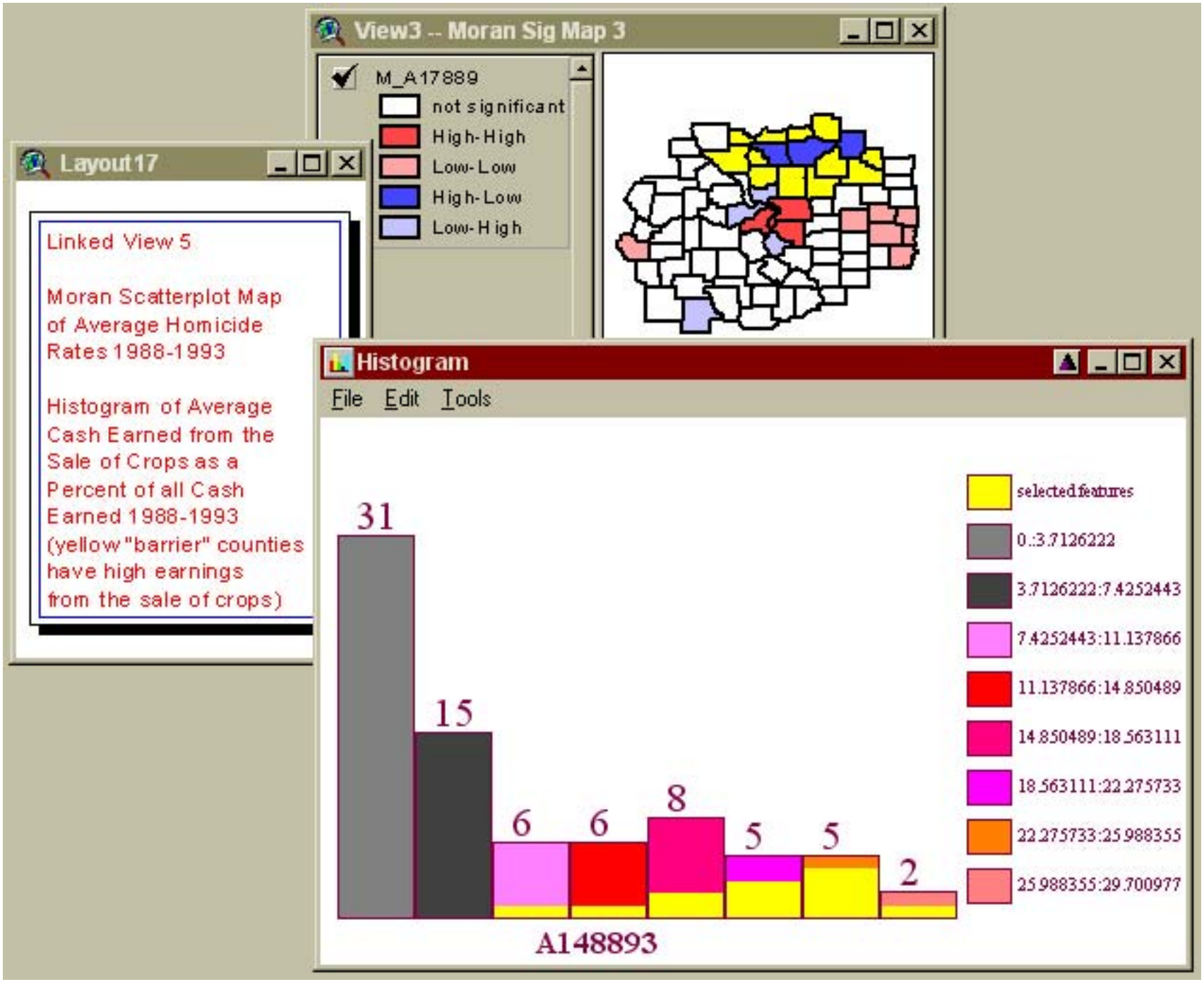
Model elaboration

Triangulation

Inductive Research

From Messner, Anselin, Baller, Hawkins, Deane, and Tolnay, 1999
Journal of Quantitative Criminology




View3 -- Moran Sig Map 3
M_A17889
not significant
High-High
Low-Low
High-Low
Low-High
Layout17
Linked View 5
Moran Scatterplot Map of Average Homicide Rates 1988-1993
Histogram of Average Cash Earned from the Sale of Crops as a Percent of all Cash Earned 1988-1993 (yellow "barrier" counties have high earnings from the sale of crops)
Histogram
File Edit Tools
31
15
6
6
8
5
5
2
A148893
selected features
0.:3.7126222
3.7126222:7.4252443
7.4252443:11.137866
11.137866:14.850489
14.850489:18.563111
18.563111:22.275733
22.275733:25.988355
25.988355:29.700977

Ordinary Least Squares (OLS) and Spatial Error Maximum Likelihood Regressions of 1980 Through 1988 Homicide Rates: Rural Counties

	OLS Model			*Spatial Error Model*
	NCHS (residence)	*NCHS (occurrence)*	*SHR*	*NCHS (occurrence)*
Resource deprivation/affluence	.385	−.211	.010	−.412
Population structure/heterogeneity	.126	−.783	.184	−.937
Percentage aged 15 to 29	−.031	−.012	−.190	.002
Percentage unemployed	.019	.133	−.012	.155
Cash from crops	−.077**	−.098**	−.032	−.090**
Moran's *I* for OLS residuals	−.022	.169**	−.026	NA
Spatial error (λ)	NA	NA	NA	.454**
R^2 (squared correlation)	.412	.378	.108	.372
N	53	53	53	53

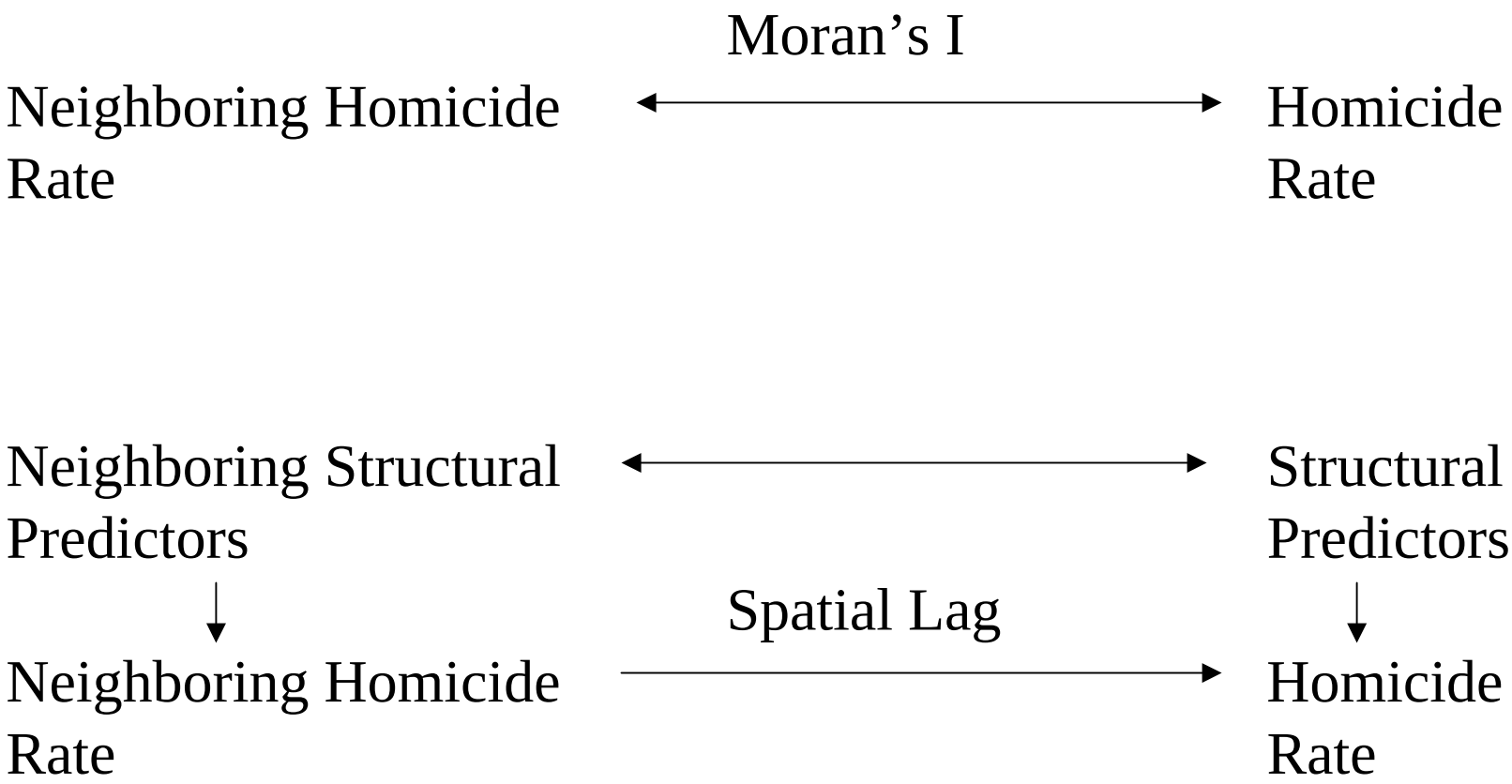
NOTE: Rural counties are those with the 53 lowest scores on population density. All models control for an intercept, and the OLS models employ White's adjusted standard errors. Tests for spatial dependence and the spatial error term are based on a 5-nearest-neighbor spatial weights matrix. OLS spatial autocorrelation diagnostics for the NCHS (occurrence) model are (1) Lagrange multiplier (LM) error = 3.796 (χ^2, degrees of freedom [df] = 1); (2) robust LM error = 2.564 (χ^2, df = 1); (3) LM lag = 2.037 (χ^2, df = 1); and (4) robust LM lag = .805 (χ^2, df = 1). NCHS = National Center for Health Statistics; SHR = Supplemental Homicide Report; NA = Not applicable.

*$p < .05$, **$p < .01$.

Measure Interchangeability

From Baller, Messner, Anselin, and Deane, 2002 Homicide Studies

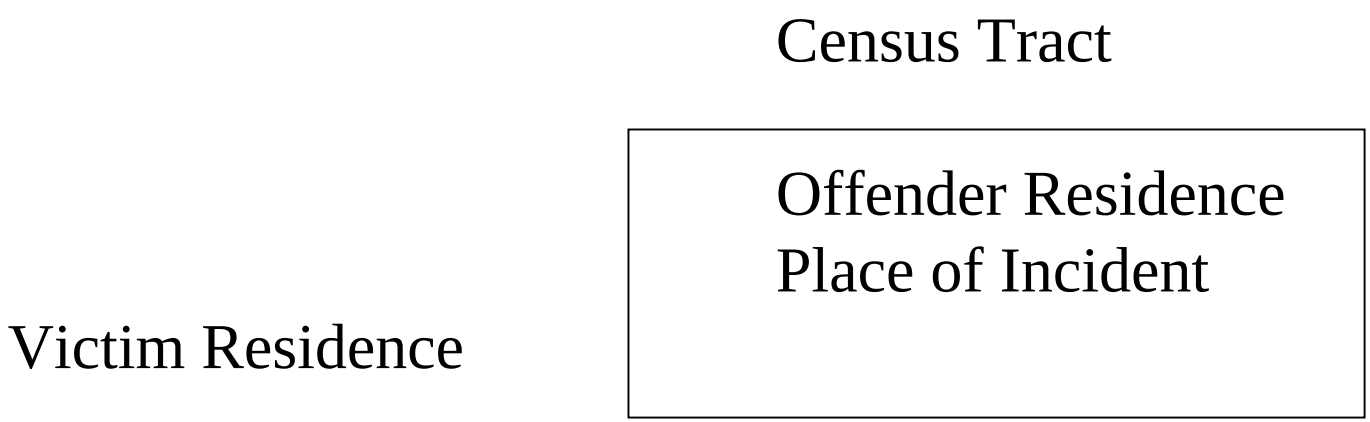
Spatial Elaboration



From Baller, Shin, and Richardson, 2003

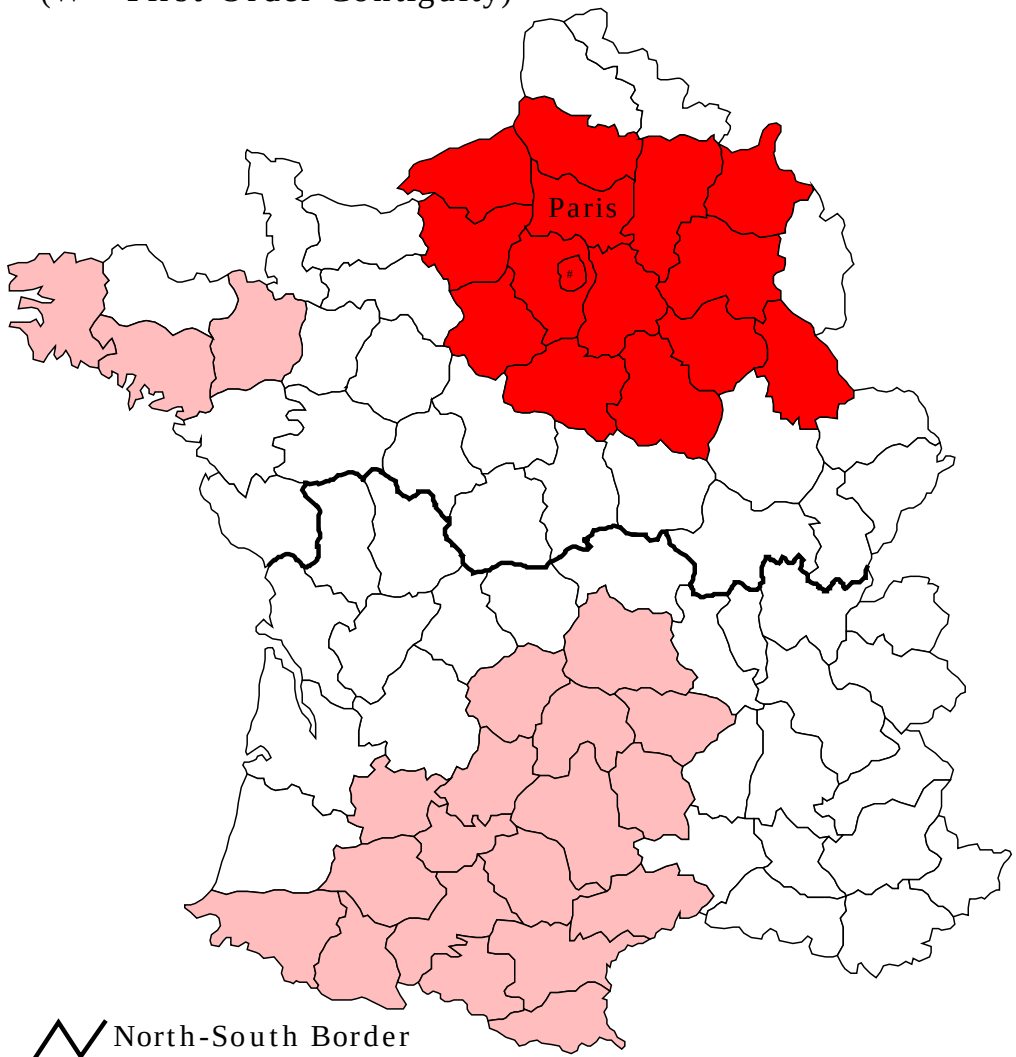
Triangulation

Defended Community Homicide: Victim comes in from another census tract, and is killed by a resident of the census tract in which the incident occurs.



From Baller, Spohn, Griffiths, and Gartner, 2003

Map 1. Moran Scatterplot Map
French Department Suicide Rates, 1872-1876
(W = First-Order Contiguity)



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