

RELATIONSHIPS BETWEEN CONSUMER HEALTH SPENDING AND MORTALITY ACROSS CENTRAL APPALACHIA




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Historical Background: Central Appalachia

- High levels of deprivation
 - High levels of mortality rates

 - Especially in eastern KY & WV
- 

Research Questions

- In what ways are deprivation & poor mortality rates reflected in consumer spending on health & education?
- What is the relationship among deprivation, mortality rates, and consumer spending on Health?

Data – for 2008

- Aggregated by county
- ESRI Demographic Update
 - Social & demographic variables
 - From Census ACS & CPS
- CDC Seerstat
 - Mortality rates
- Variables
 - Demography
 - Income
 - Household structure
 - Employment
 - Educational attainment
 - Marital patterns
 - Consumer spending
 - Health & education

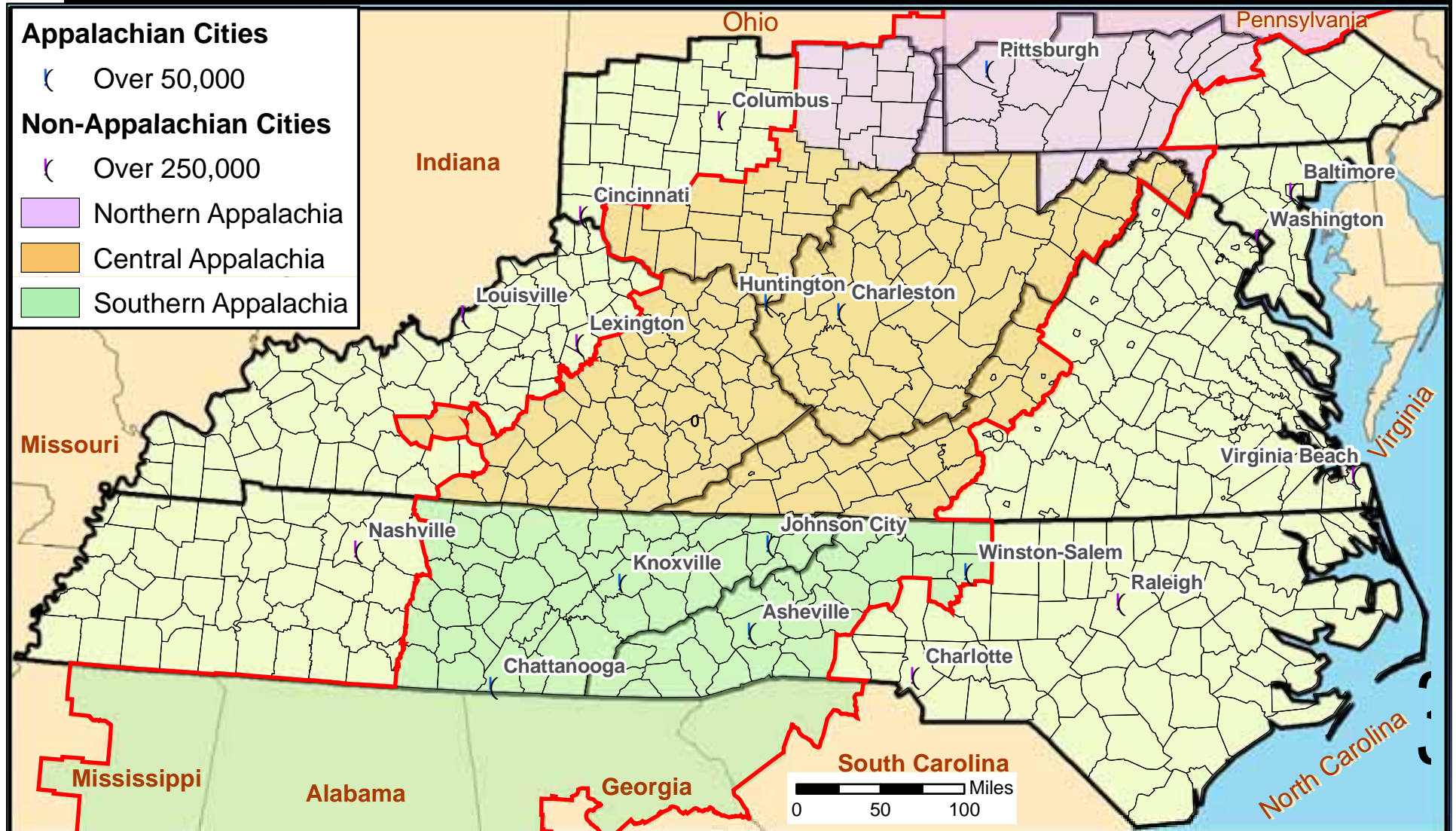
ESRI Consumer Spending 2008

- Sources
 - Consumer Expenditure Surveys from BLS
 - ESRI's Community Tapestry segmentation system.
 - A conditional probability model
- Consumer spending
 - Total expenditure - aggregate amount spent by all households in an area
 - Average amount spent per household
 - Per capita spending

Mortality Variables - 2005

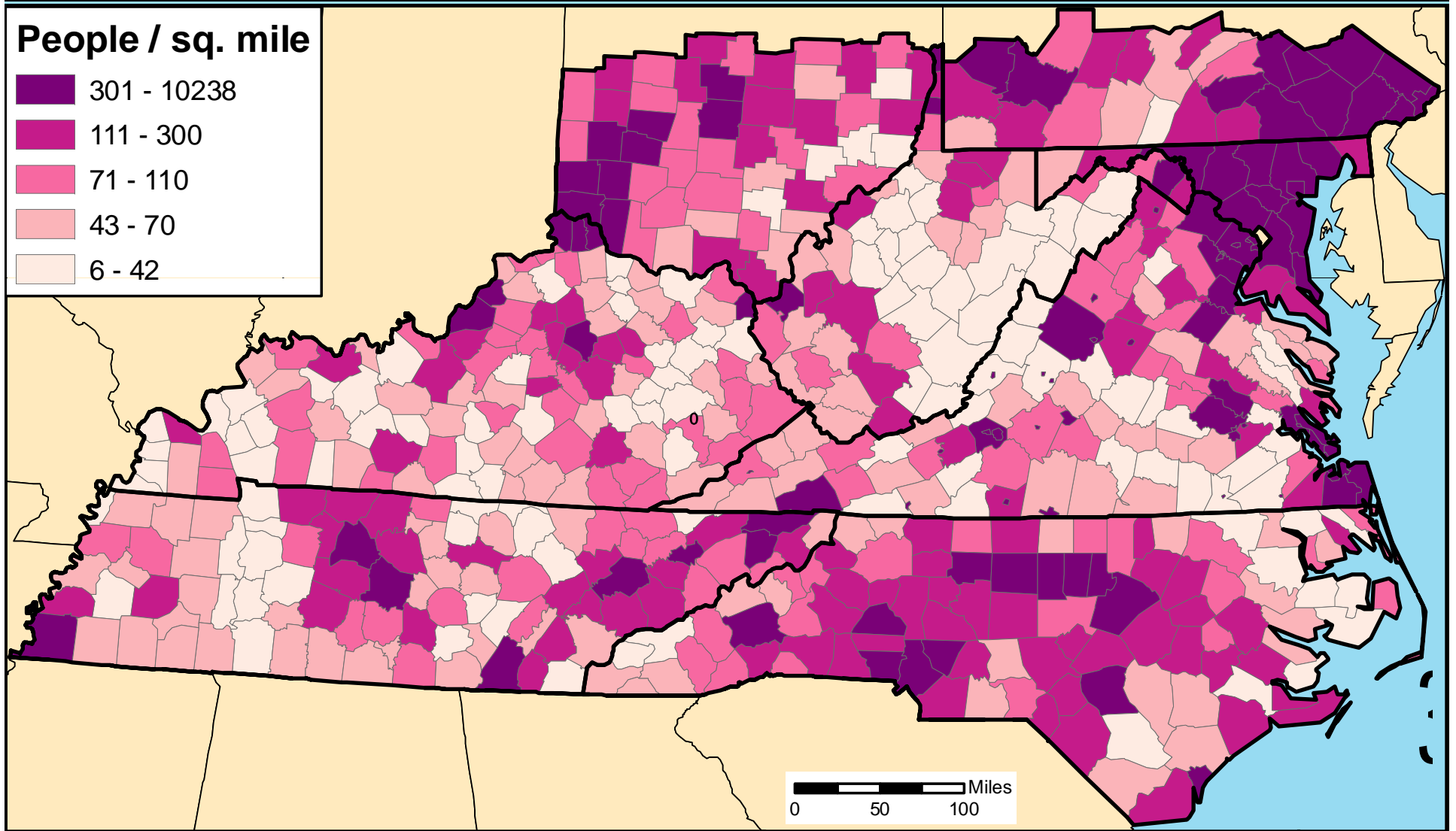
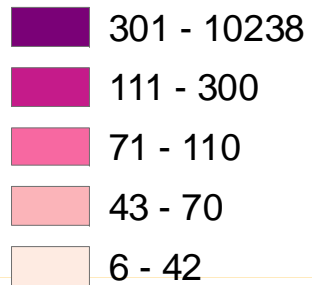
- All causes
- Diseases of Heart
- All Cancers
- Chronic Obstructive Pulmonary Disease

Study Area



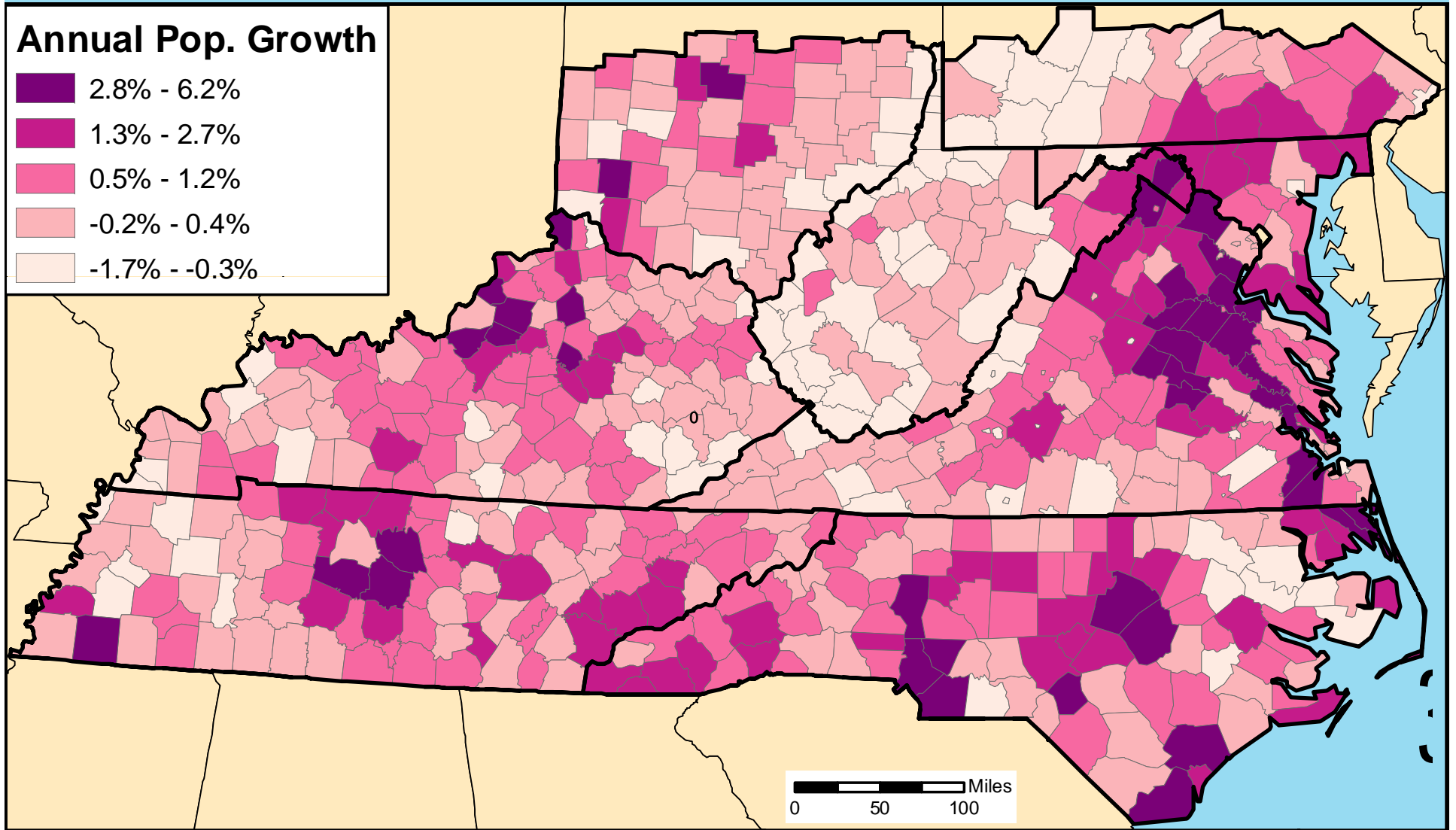
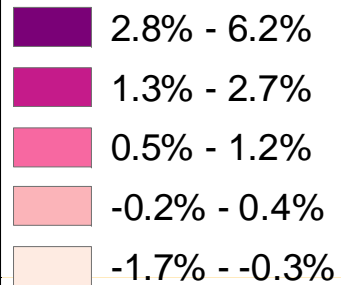
Population Density

People / sq. mile



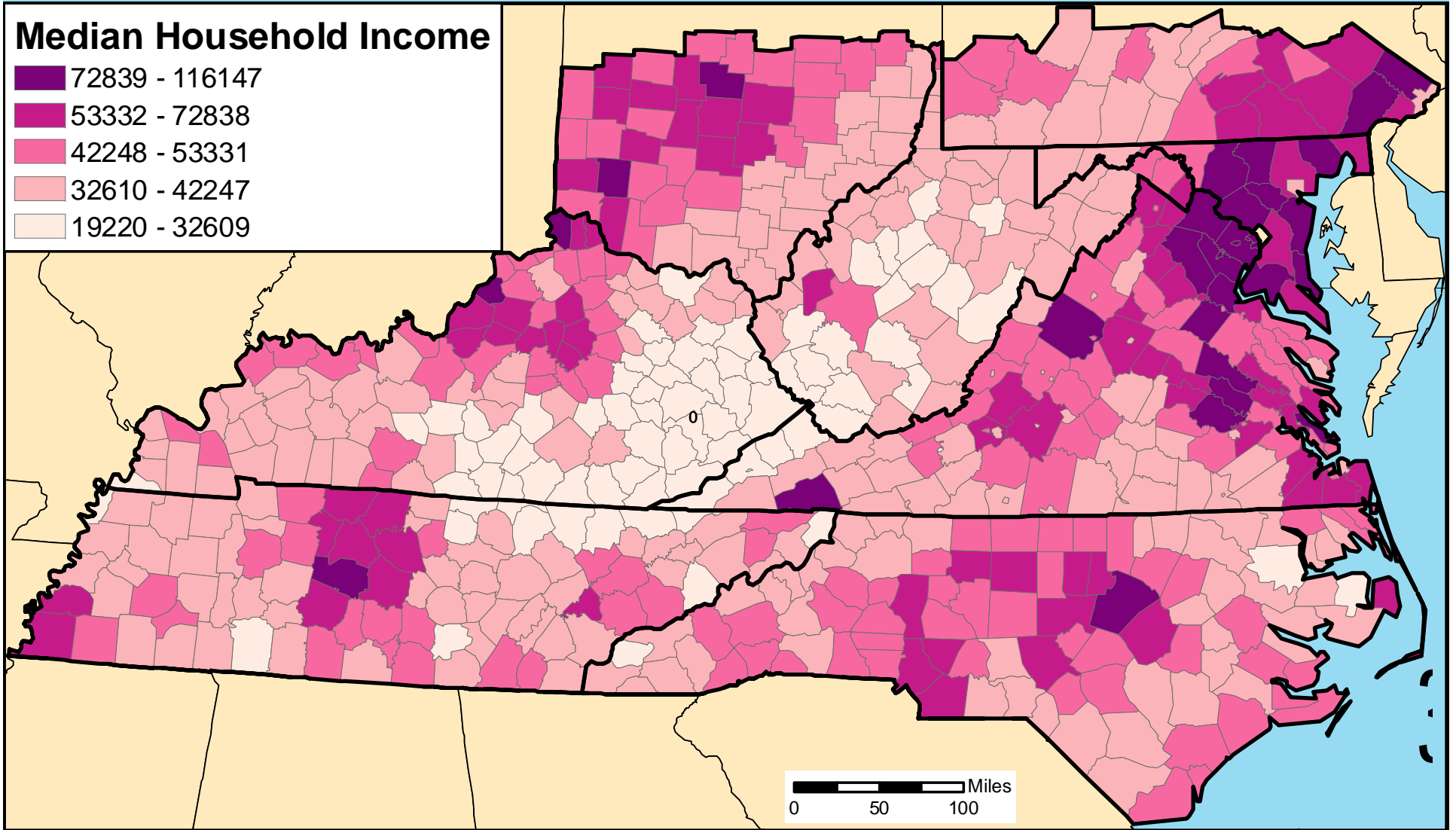
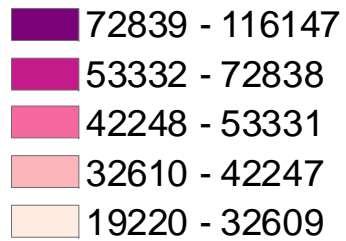
Annual % Population Growth

Annual Pop. Growth

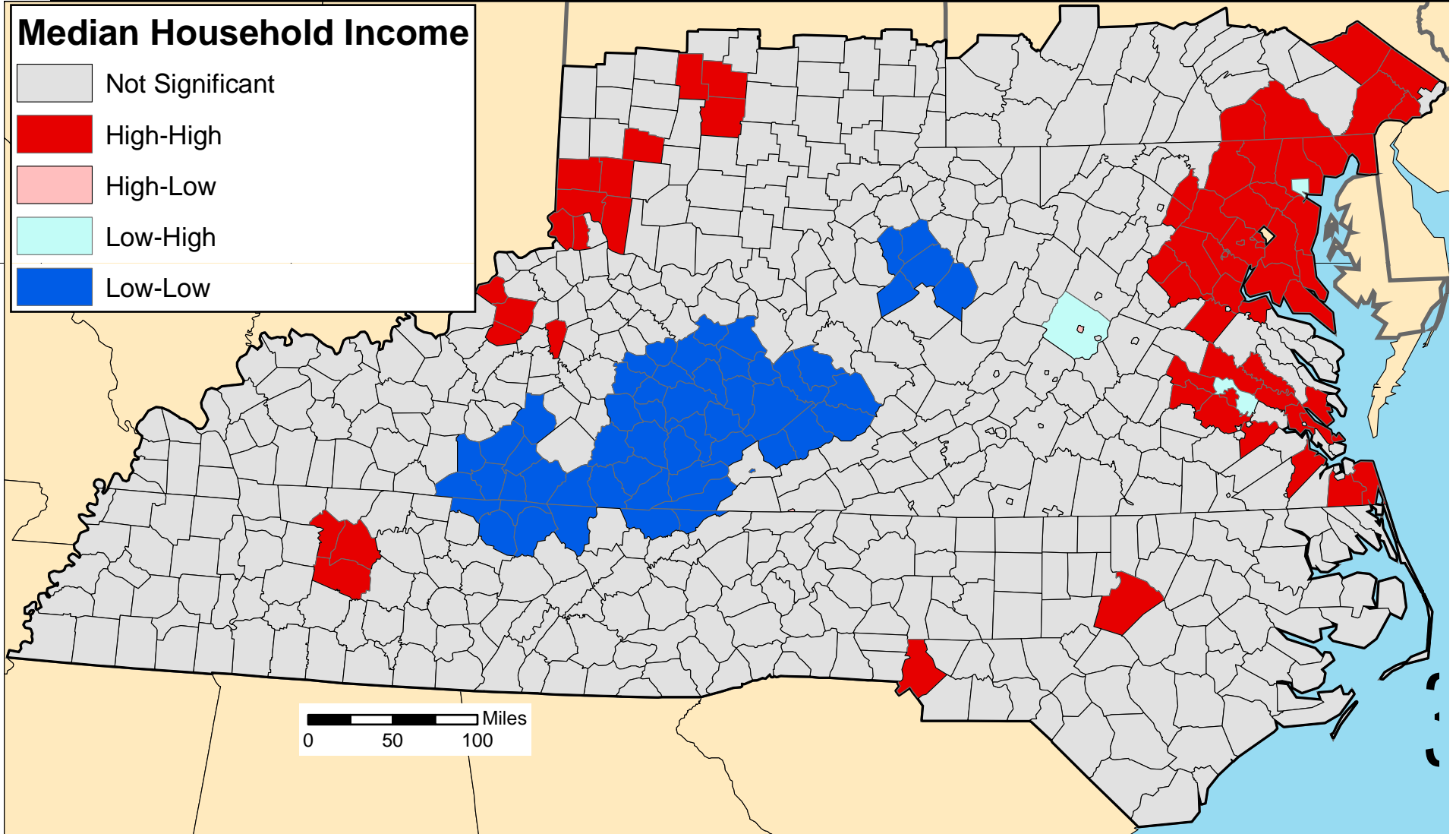


Median Household Income

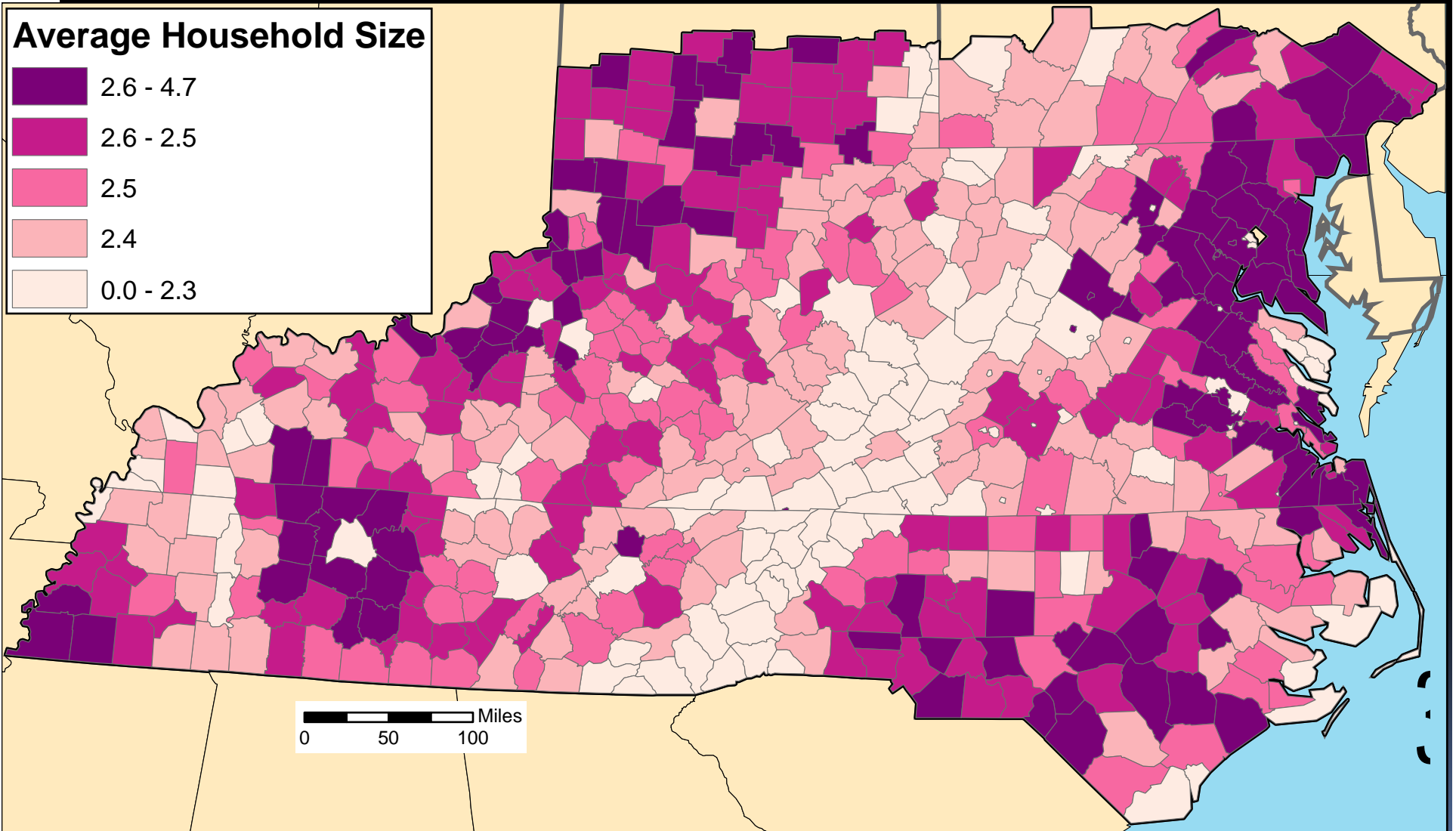
Median Household Income



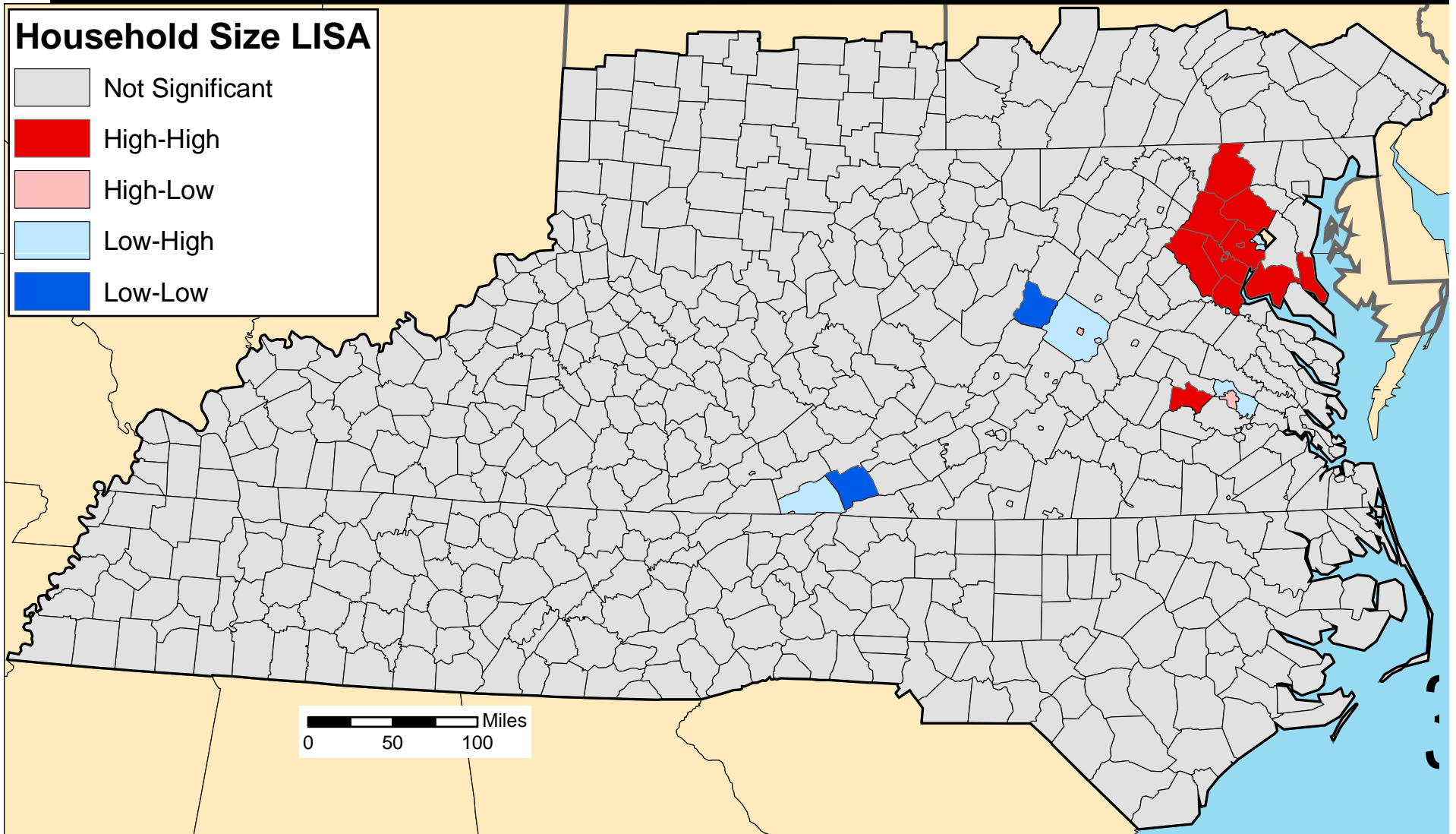
Median Household Income LISA Cluster Map



Average Household Size

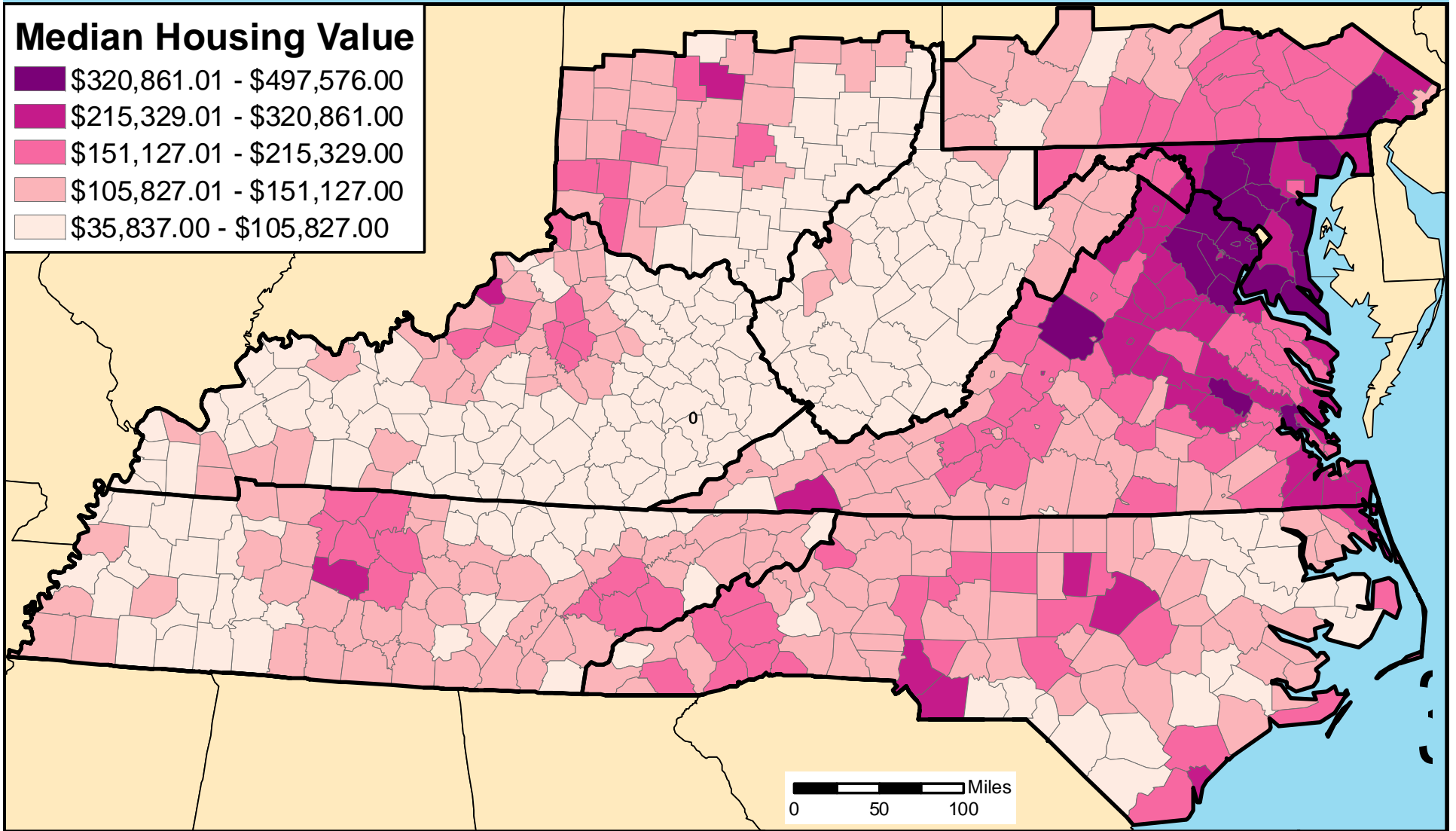
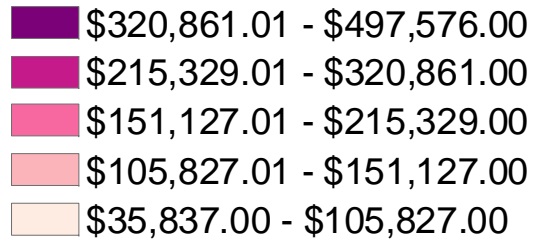


Average Household Size LISA Cluster Map



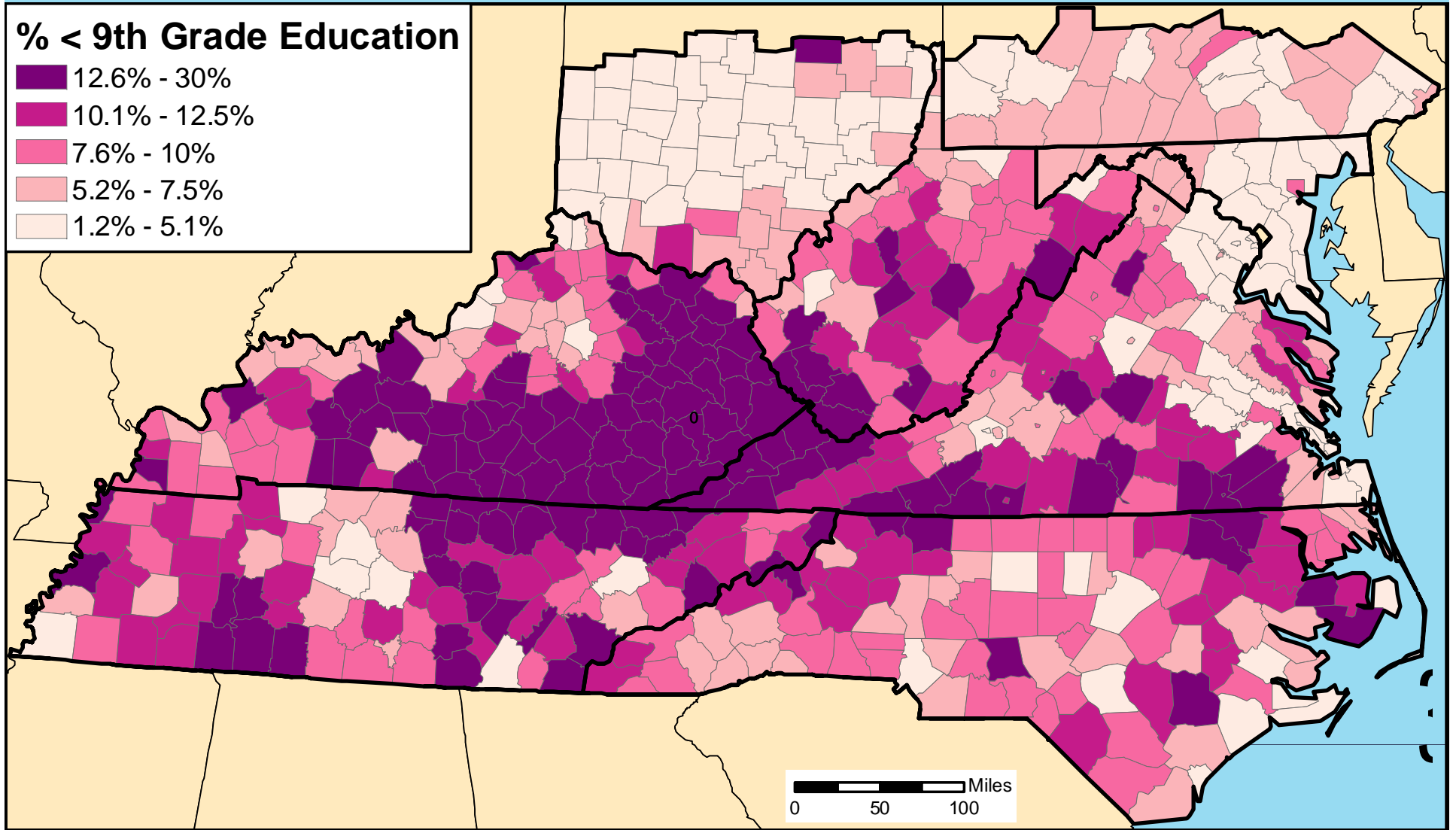
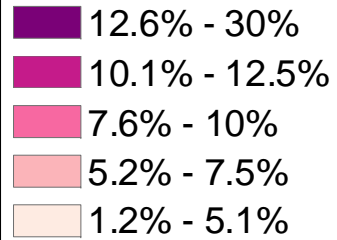
Median Housing Value

Median Housing Value



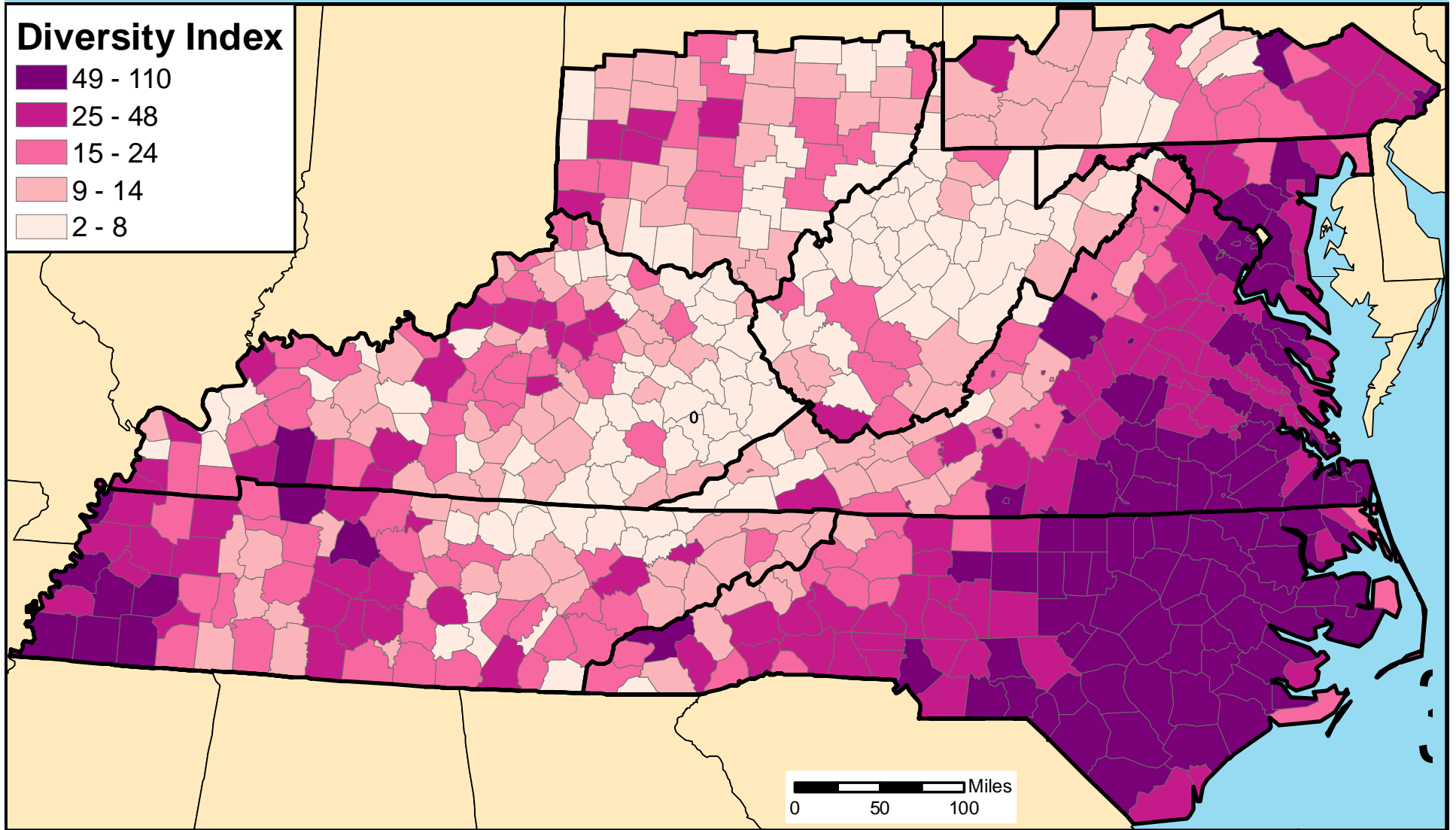
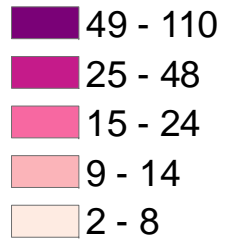
% of People 25+ with Less Than 9th Grade Education

% < 9th Grade Education



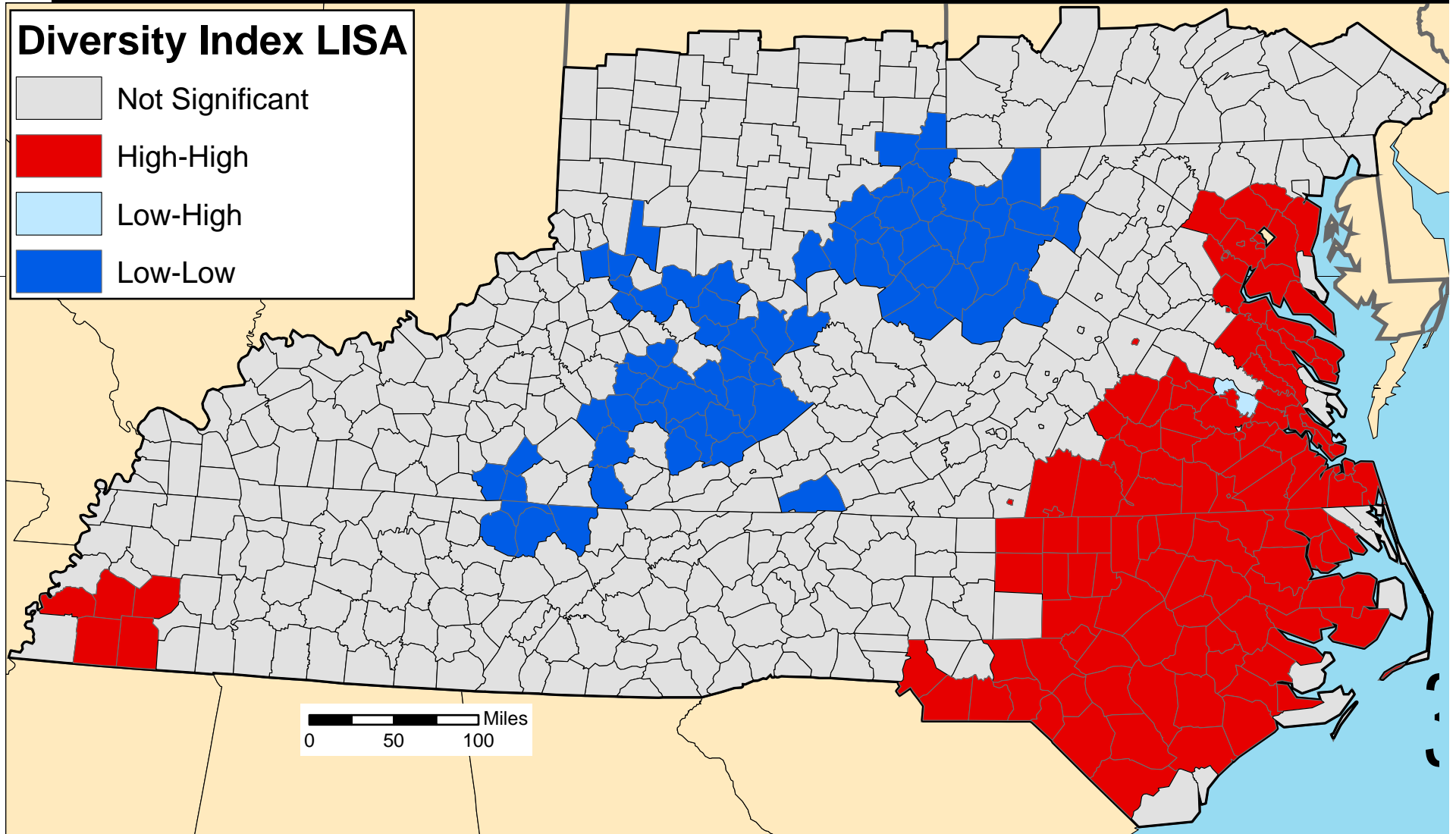
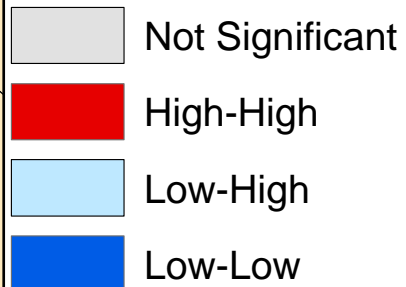
Diversity Index

Diversity Index



Diversity Index LISA Cluster Map

Diversity Index LISA

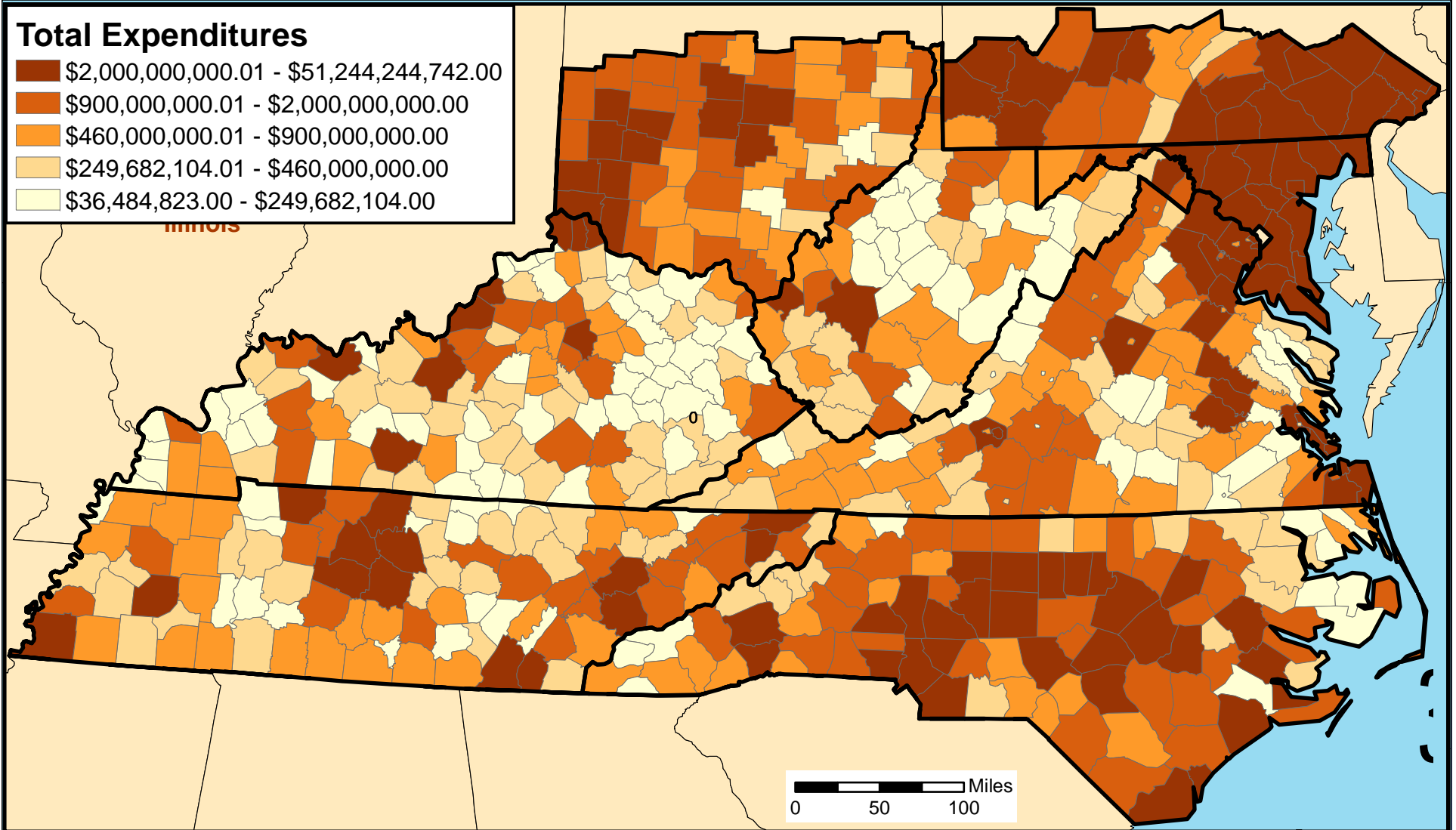
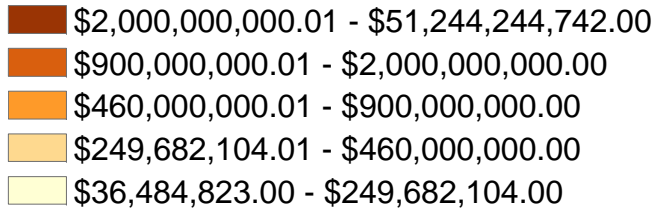


Consumer Spending

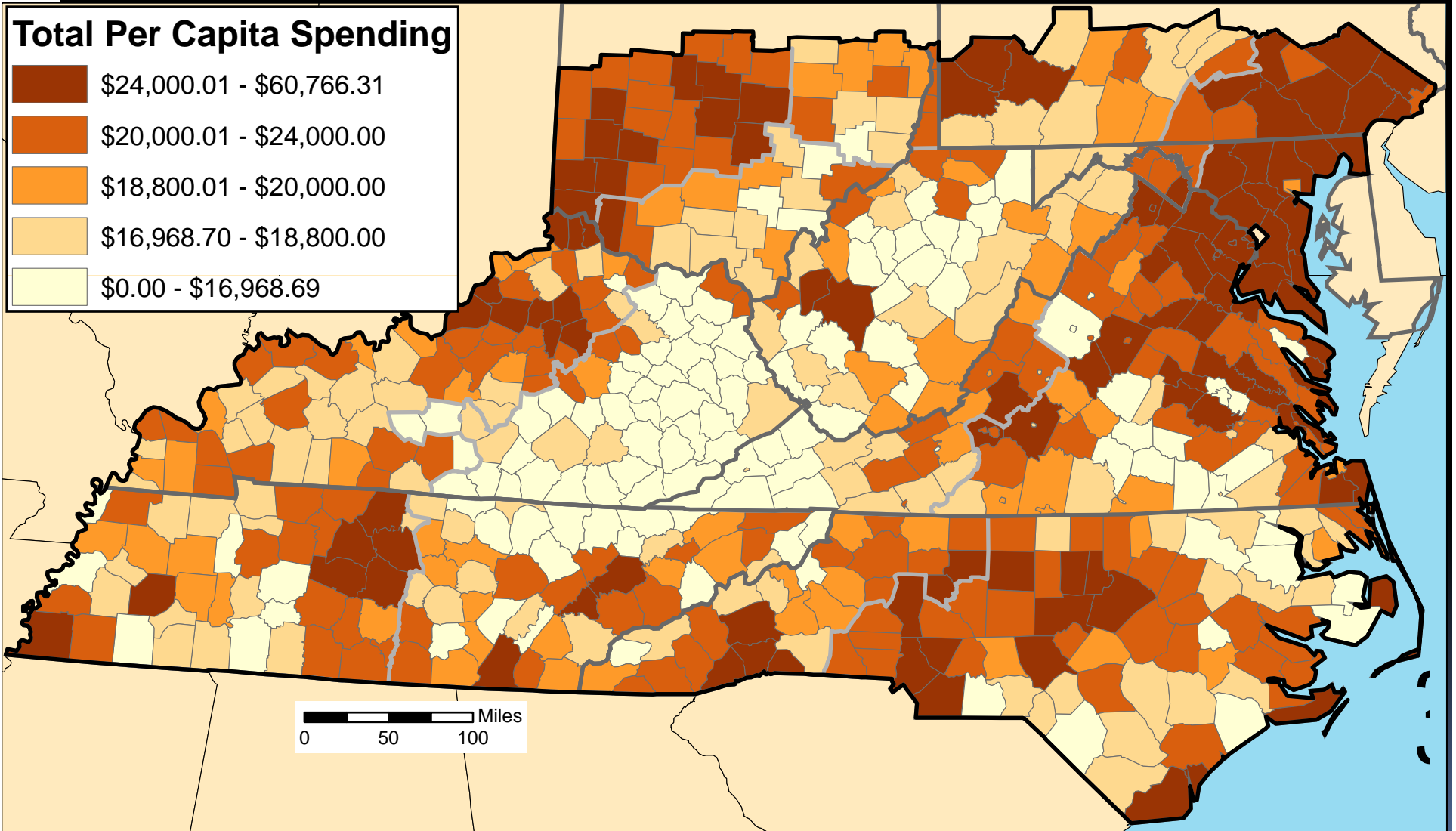
- Total Expenditures
- Health Care Spending (% of Total Spending)
- Health Care Spending per Household
- Health Insurance Spending (% of Total)
- Health Insurance Spending per household
- Medical Care Spending (% of Total Spending)
- Medical Care Spending per household
- Hospital Spending (% of Total Spending)
- Hospital Spending per Household
- Education Spending (% of Total Spending)
- Education Spending per household

Total Expenditures

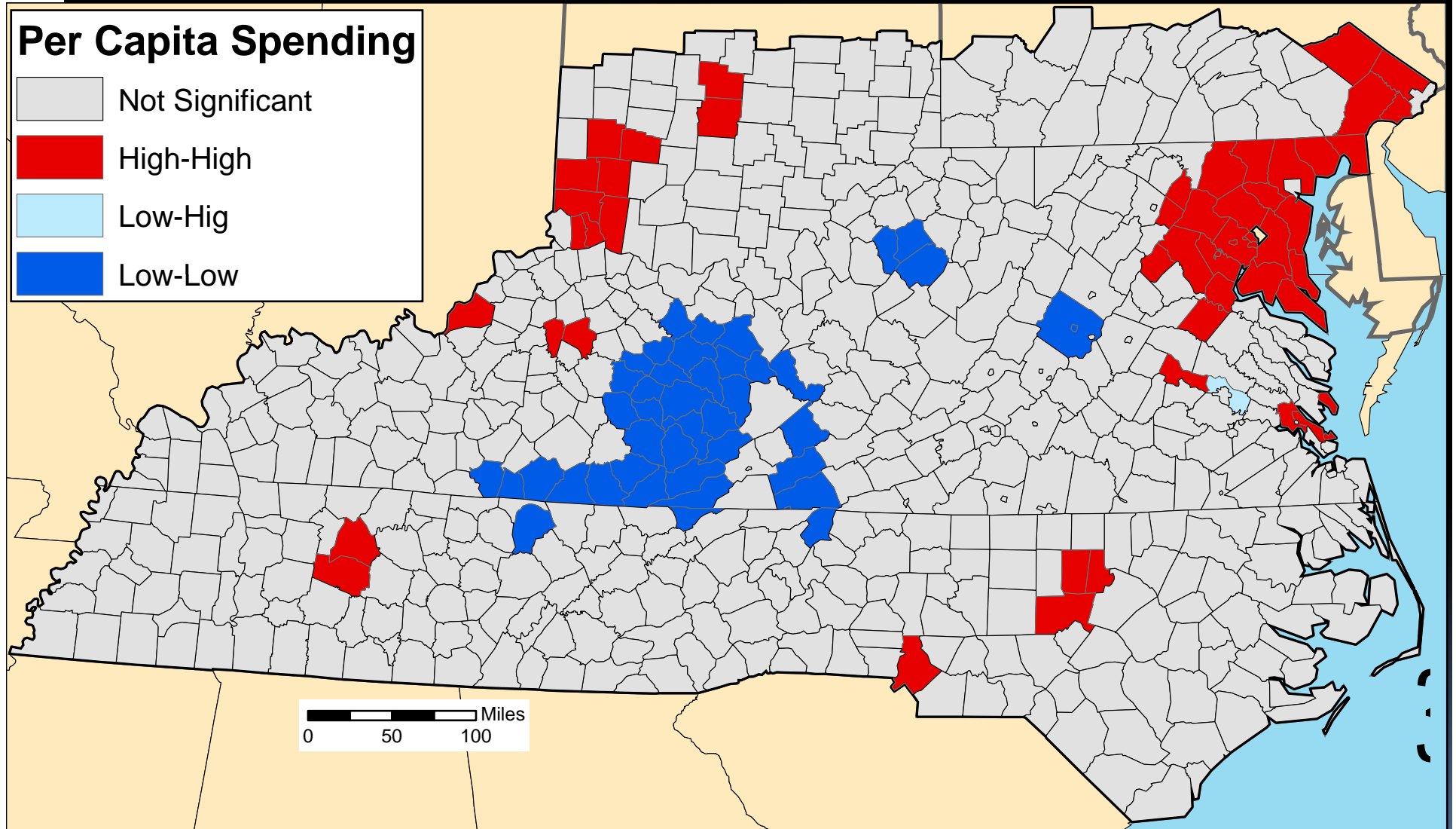
Total Expenditures



Total Expenditures (per capita)

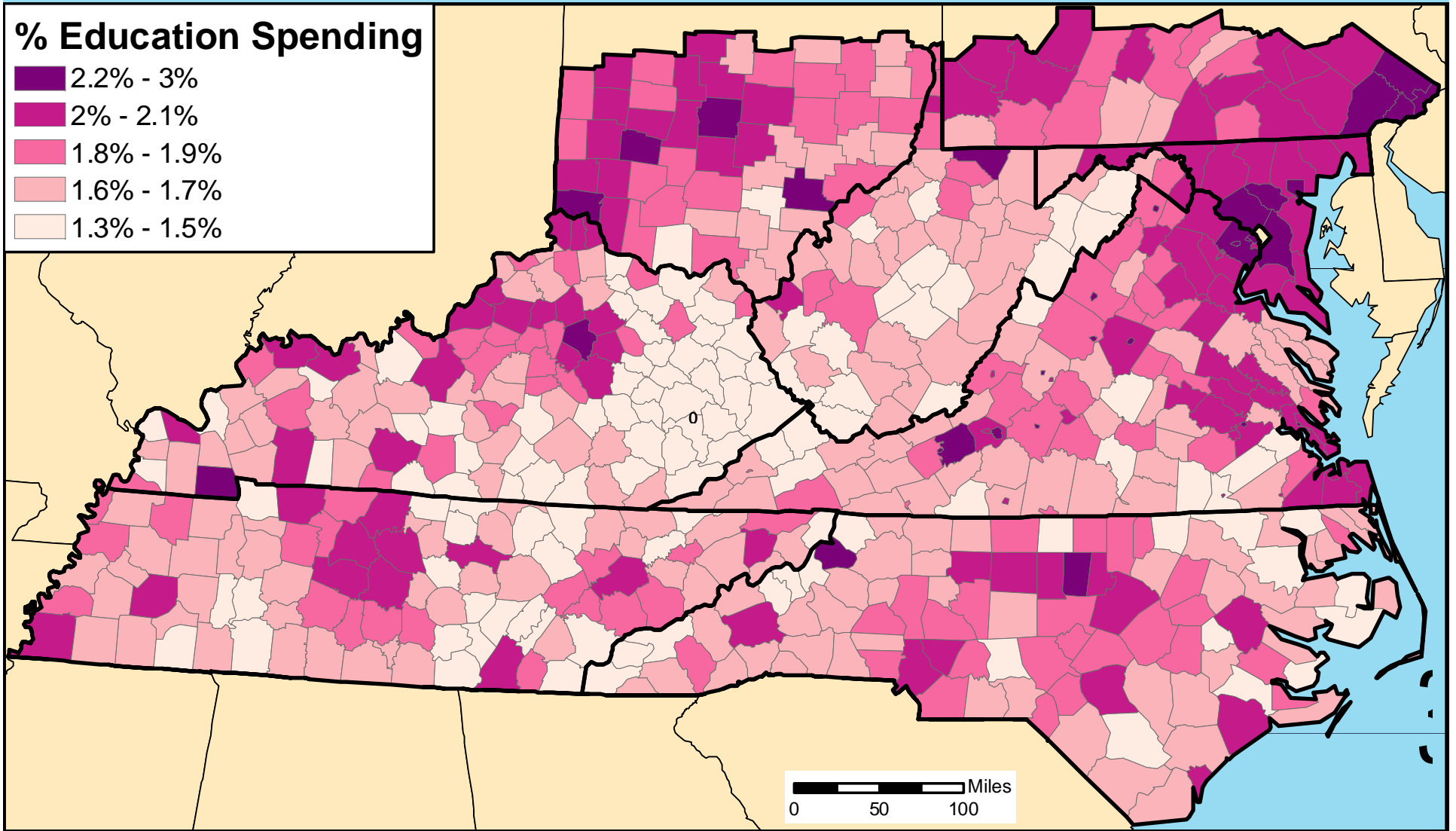
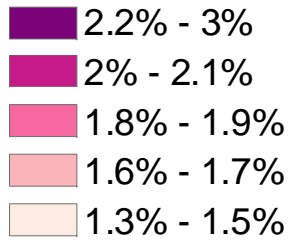


Total Expenditures per Capita LISA Cluster Map

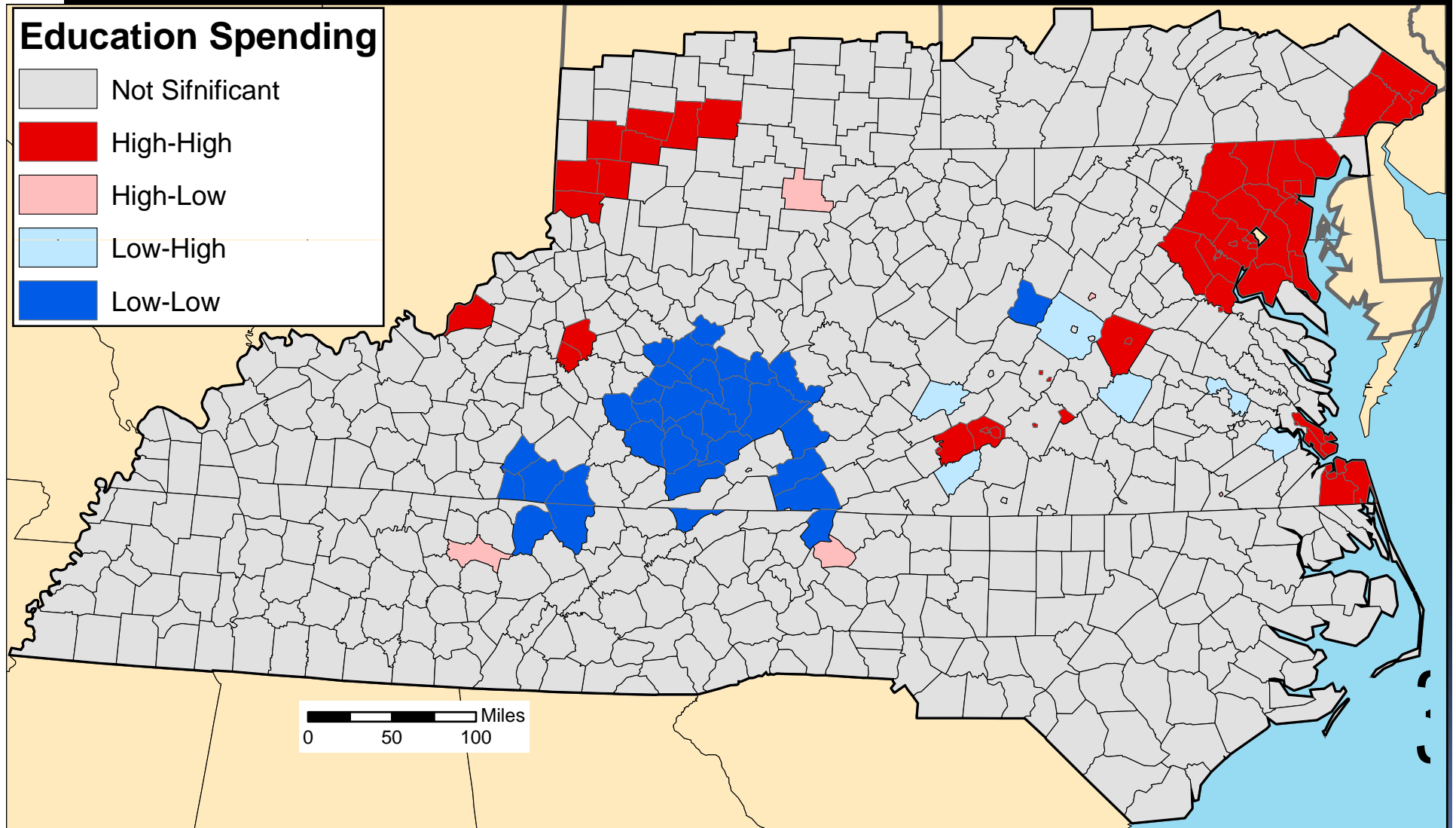


Education Spending (% of Total Spending)

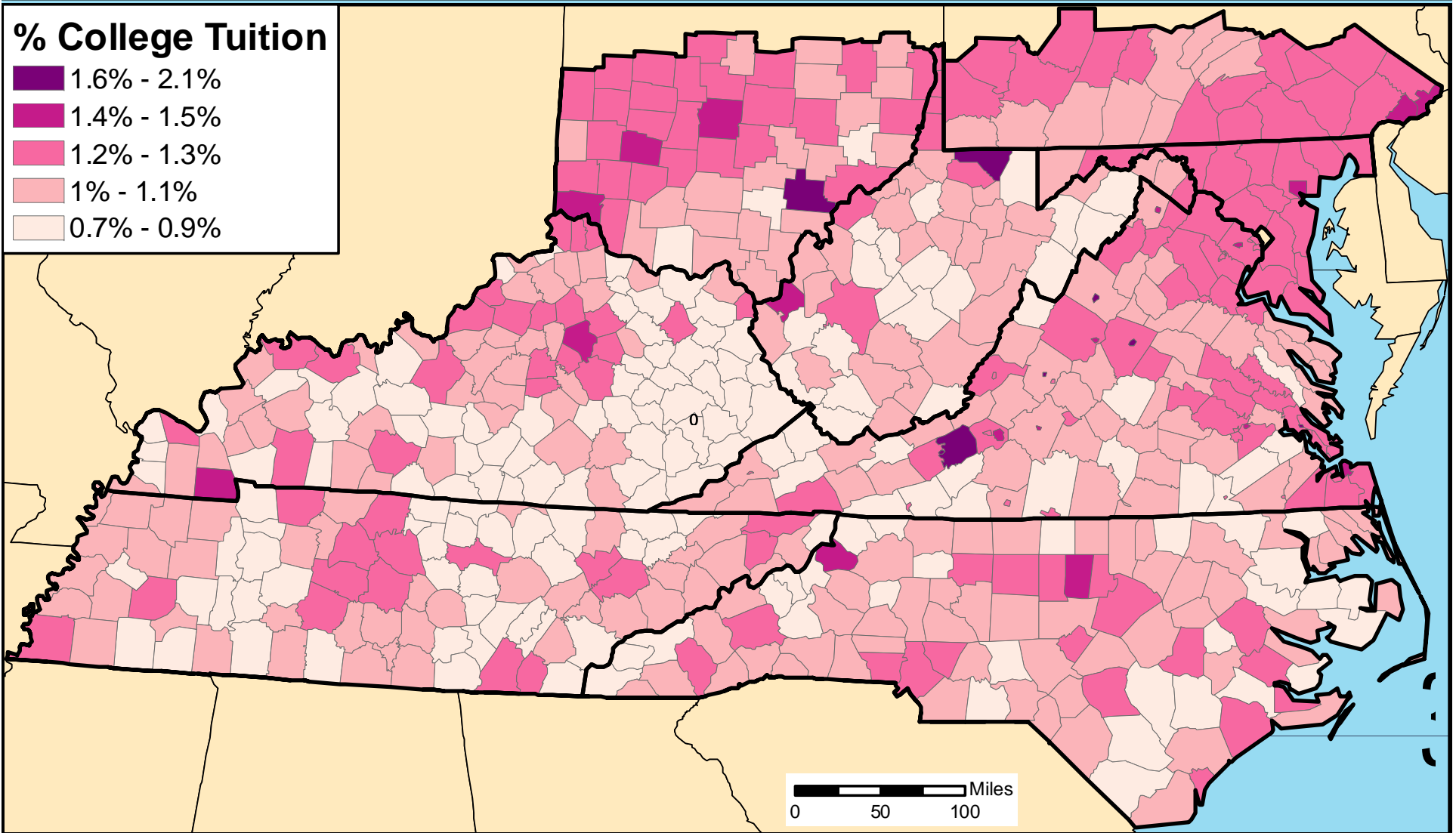
% Education Spending



Education Spending as a % of Total LISA Cluster Map

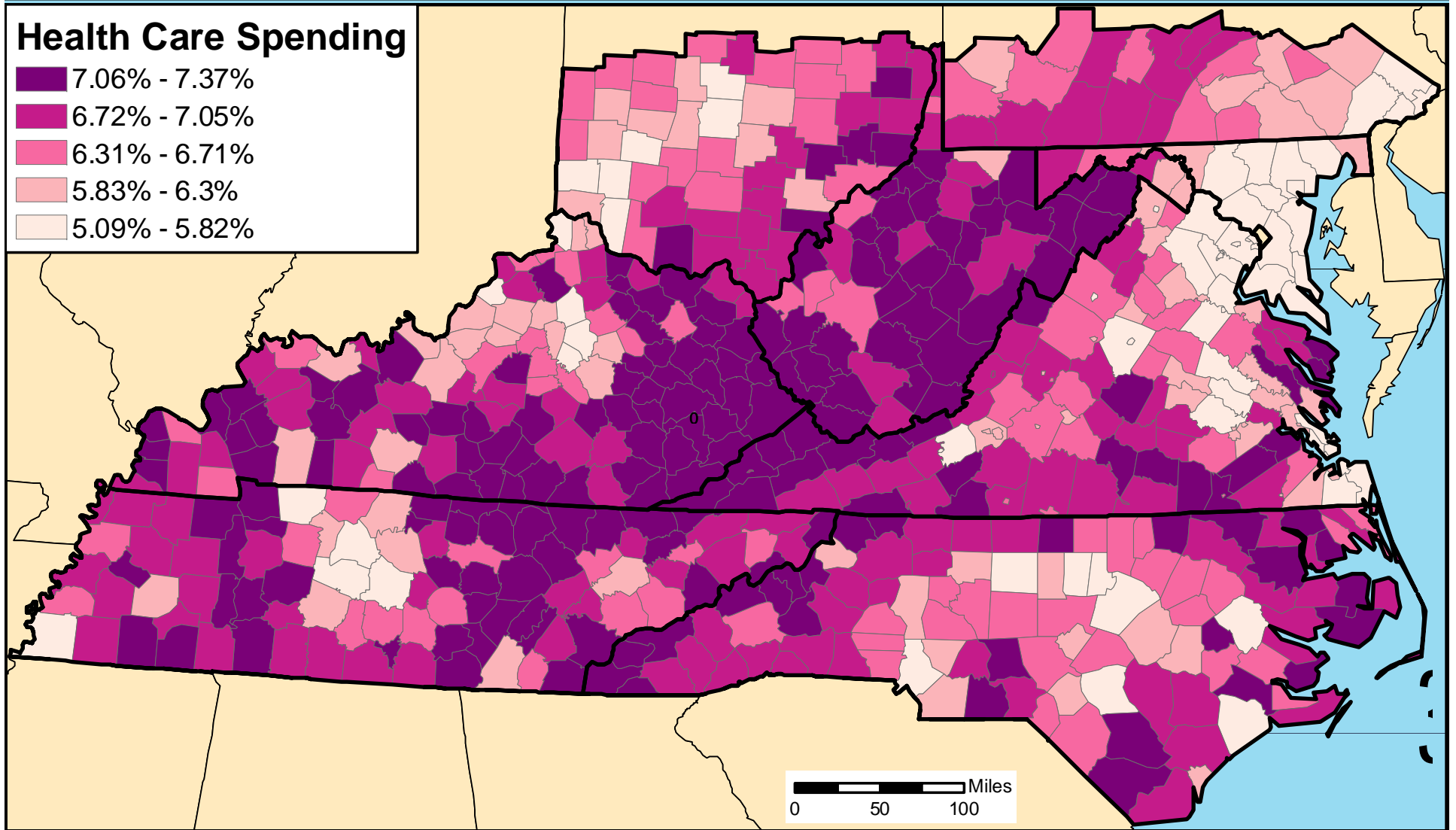
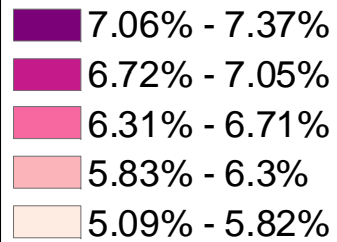


College Tuition Spending (% of Total Household Spending)

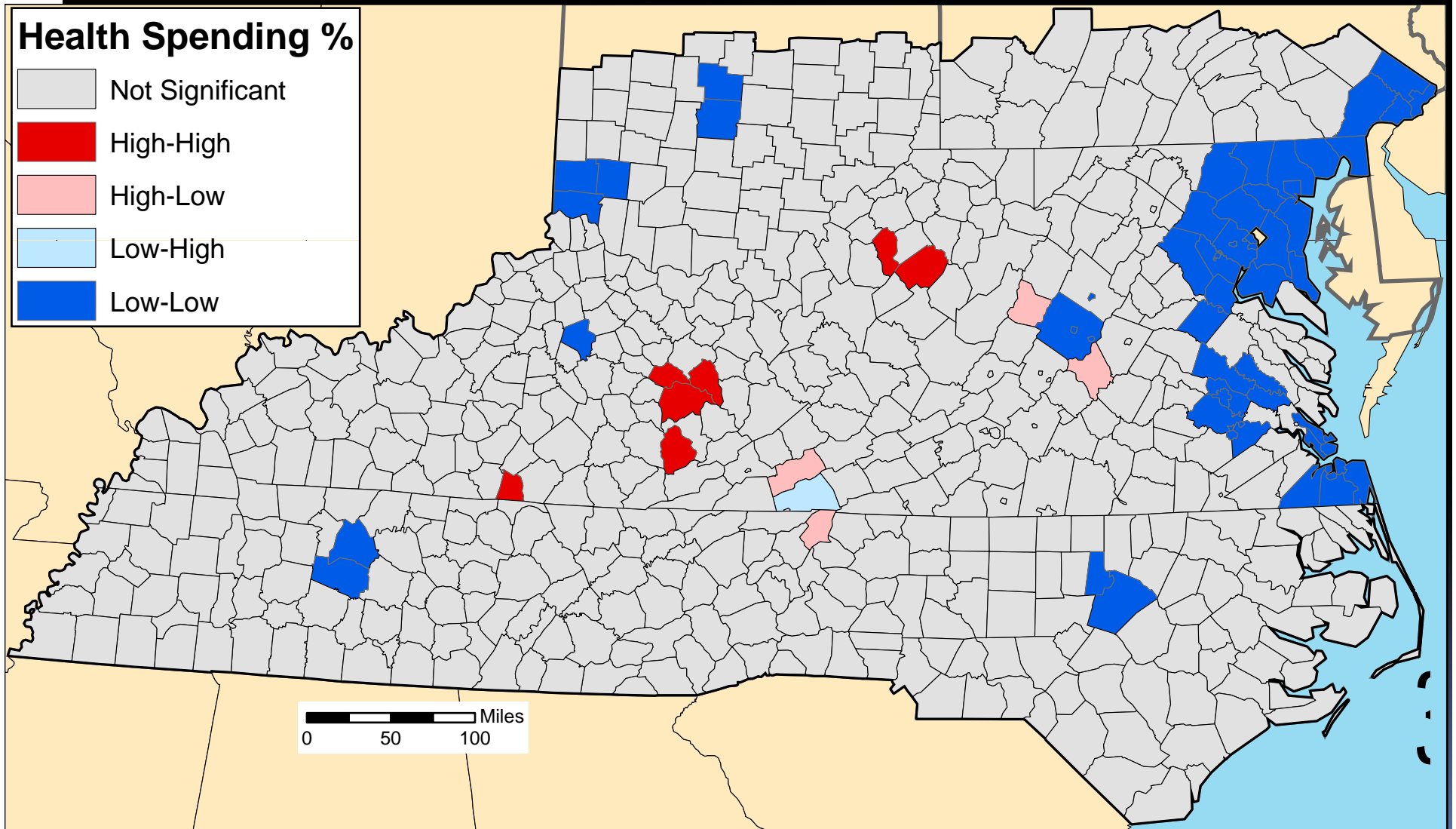


Health Care Spending (% of Total Household Spending)

Health Care Spending

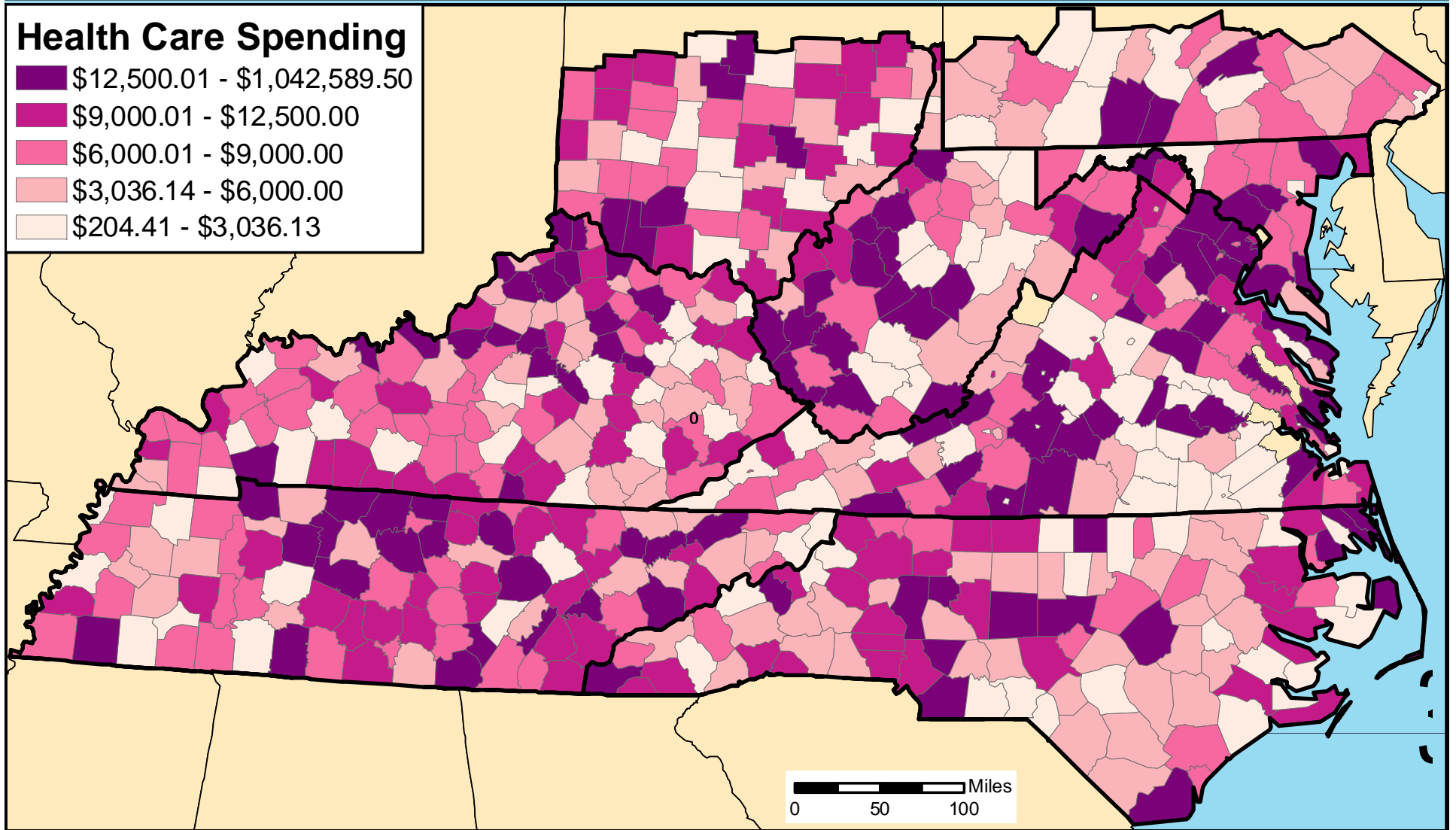
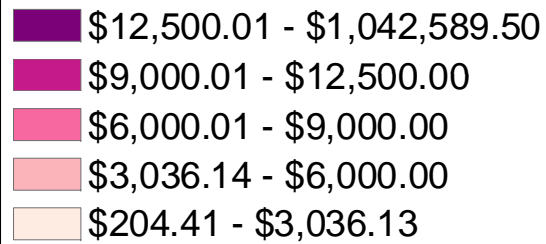


Health Spending as % of Total LISA Cluster Map



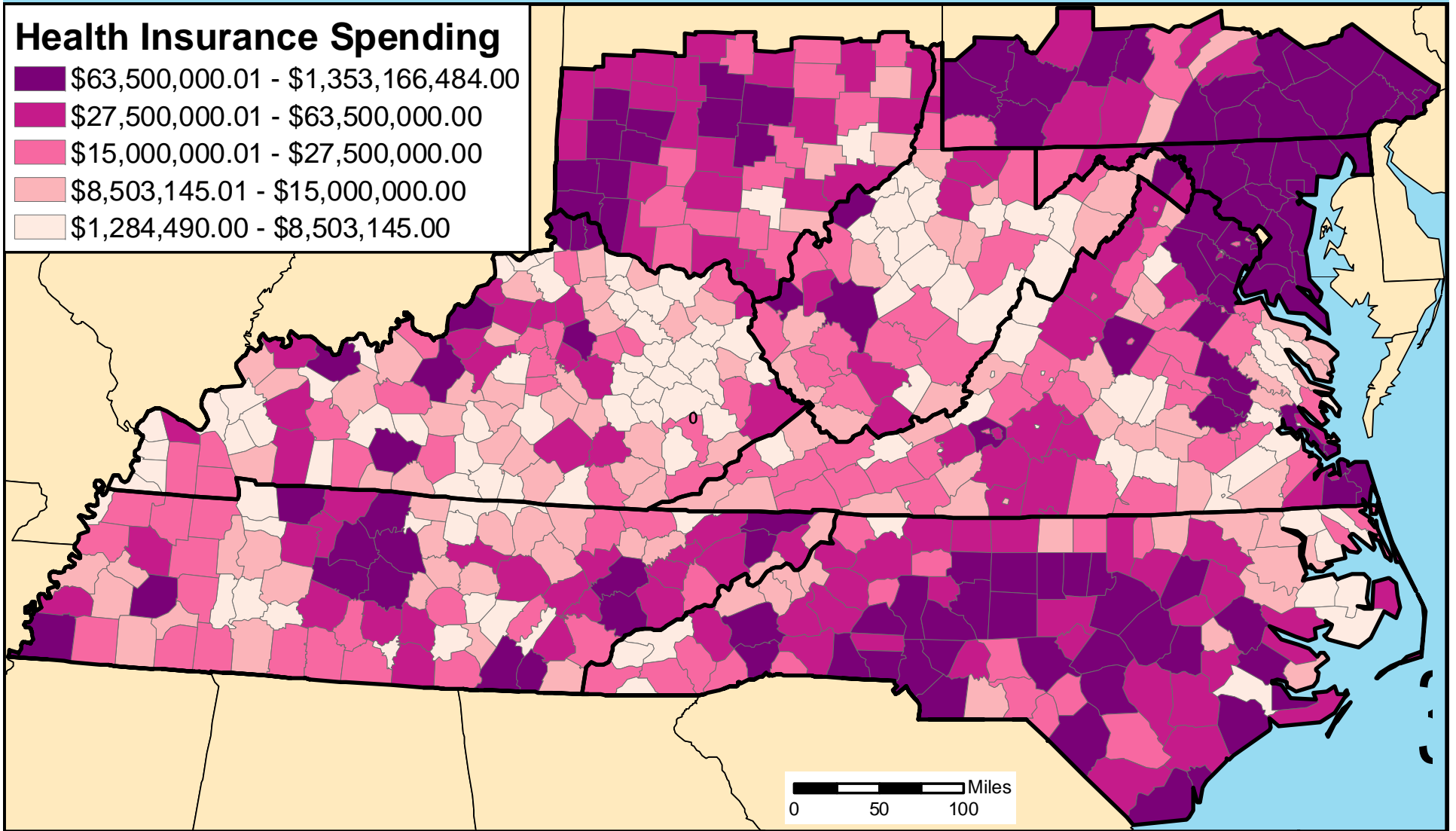
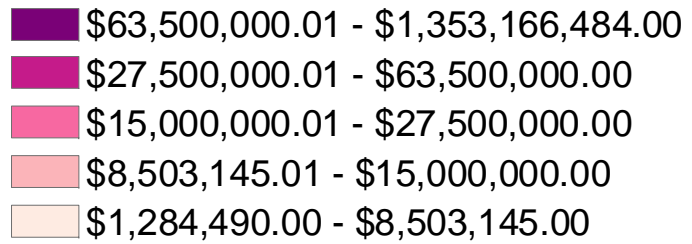
Health Care Spending *per capita*

Health Care Spending



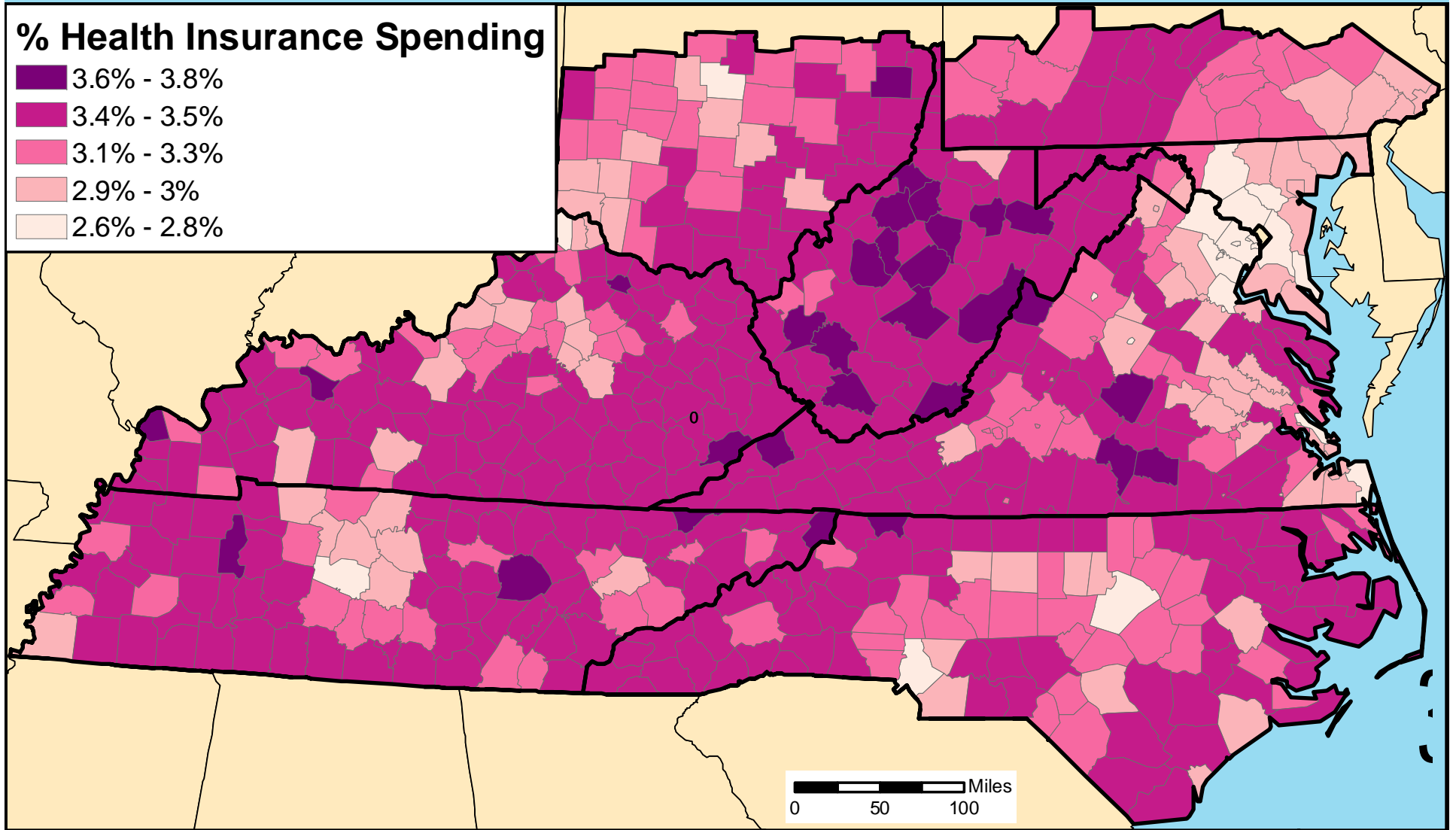
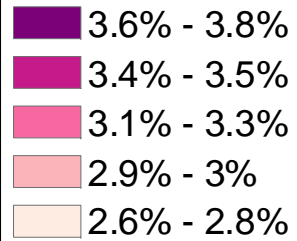
Health Insurance Spending

Health Insurance Spending



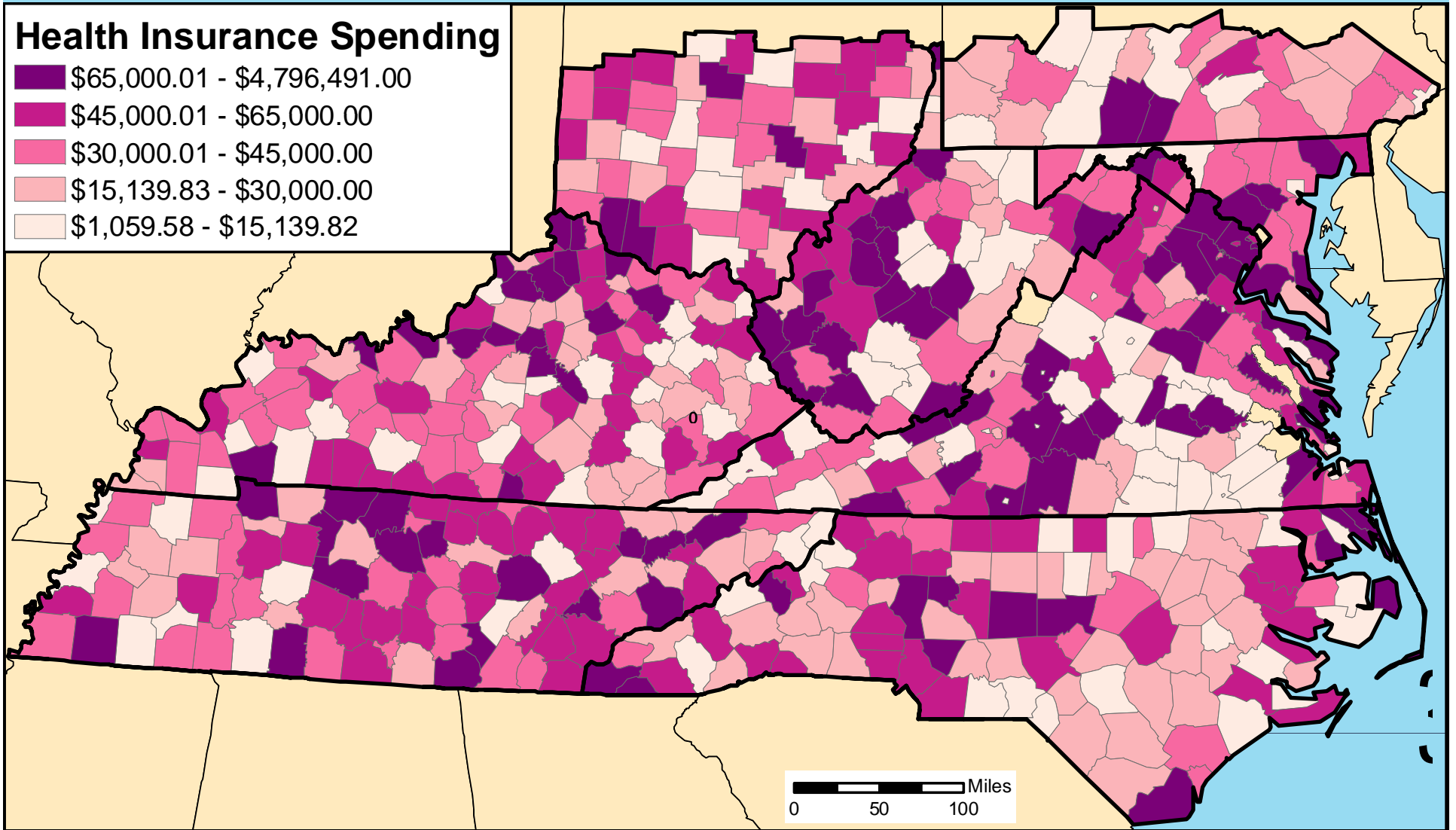
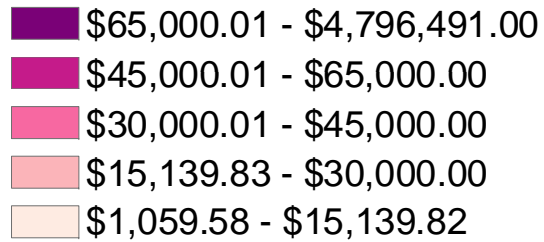
Health Insurance Spending (% of Total Expenditures)

% Health Insurance Spending



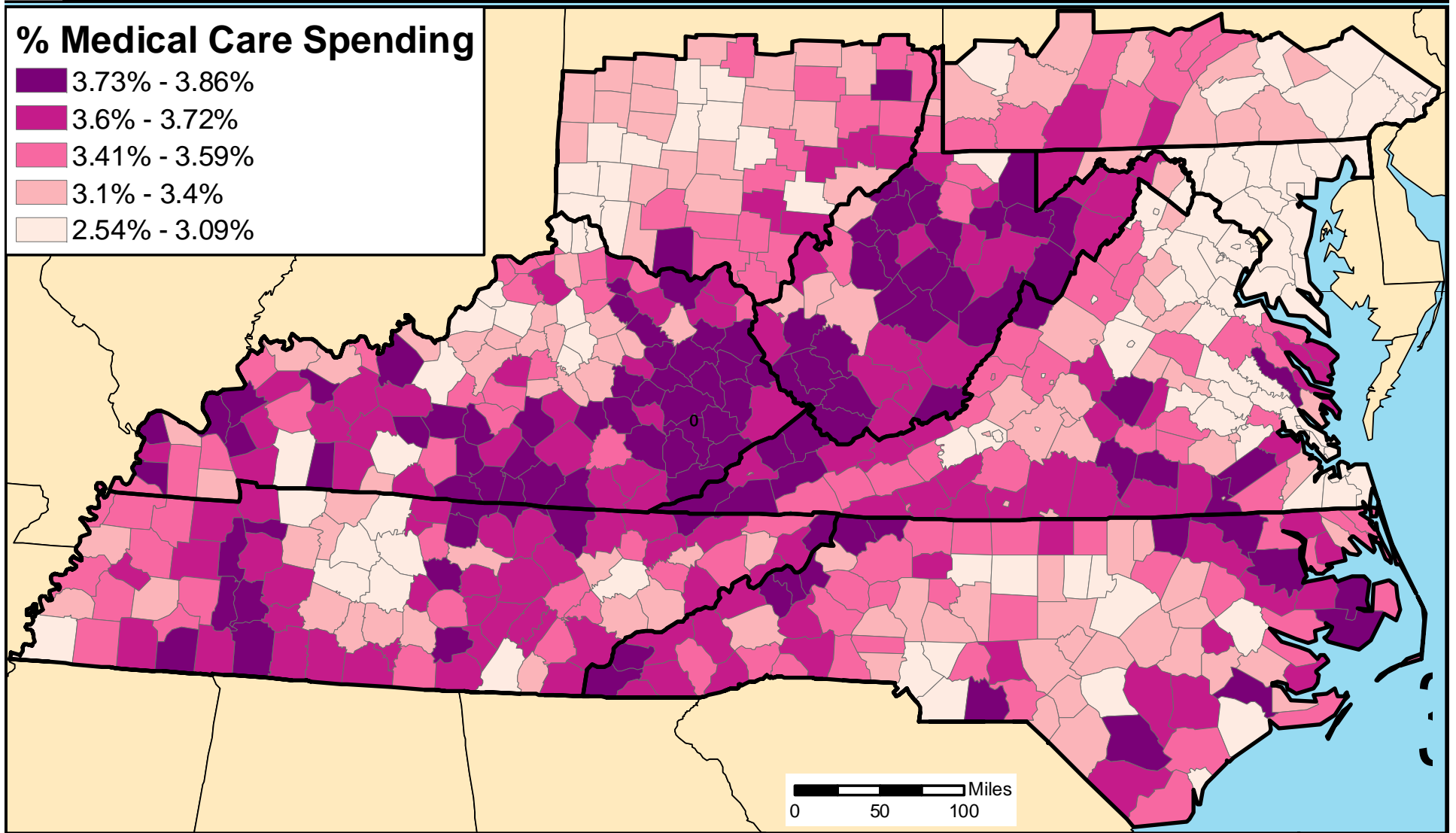
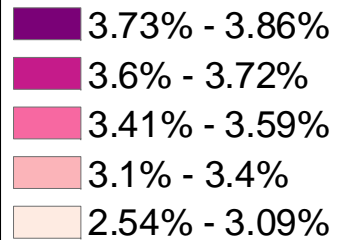
Health Insurance Spending per Household

Health Insurance Spending



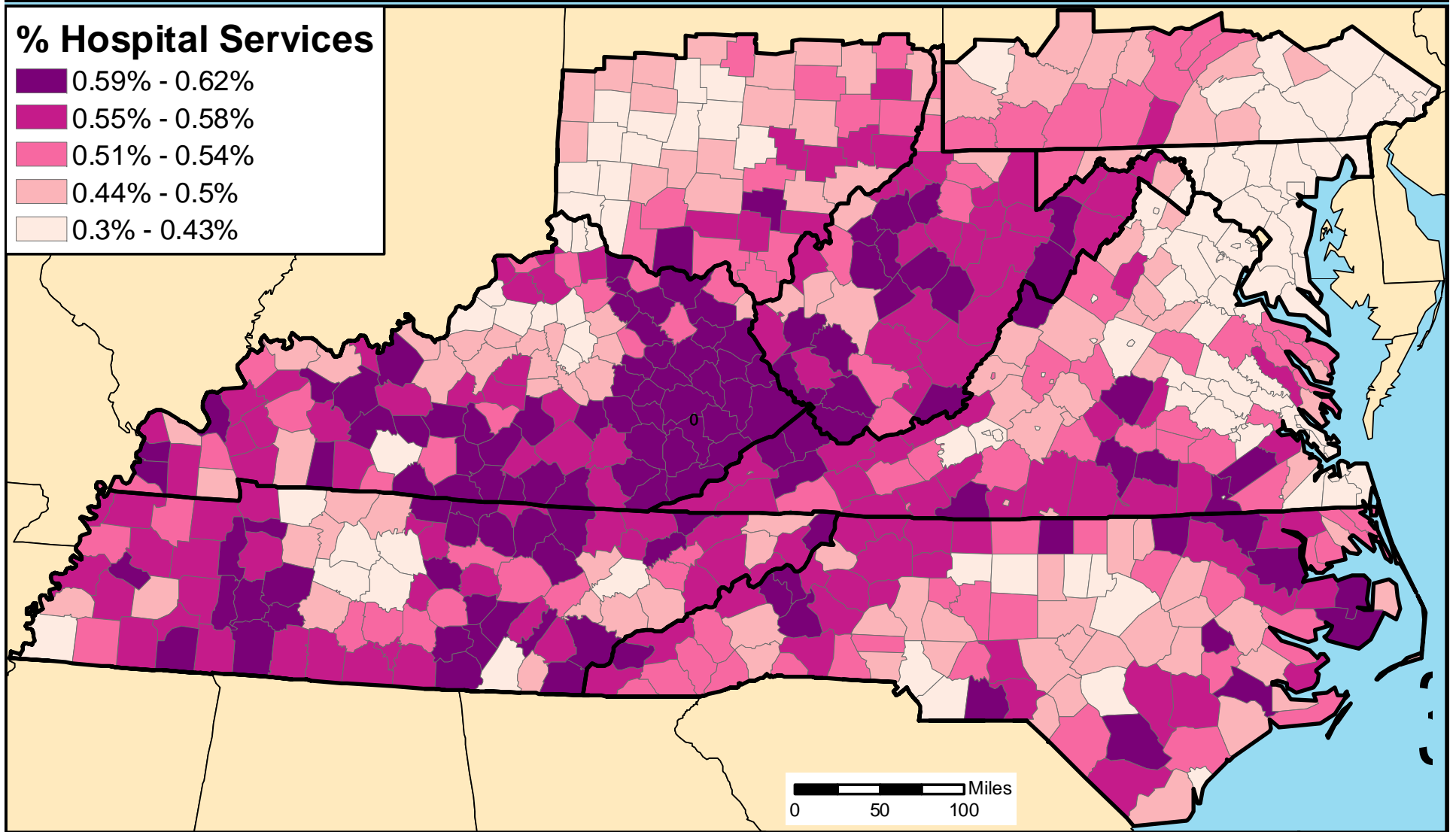
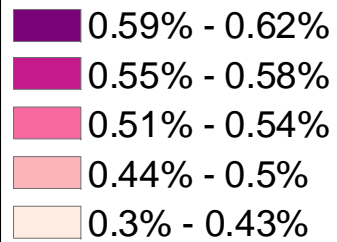
Medical Care Spending (% of Total Spending)

% Medical Care Spending



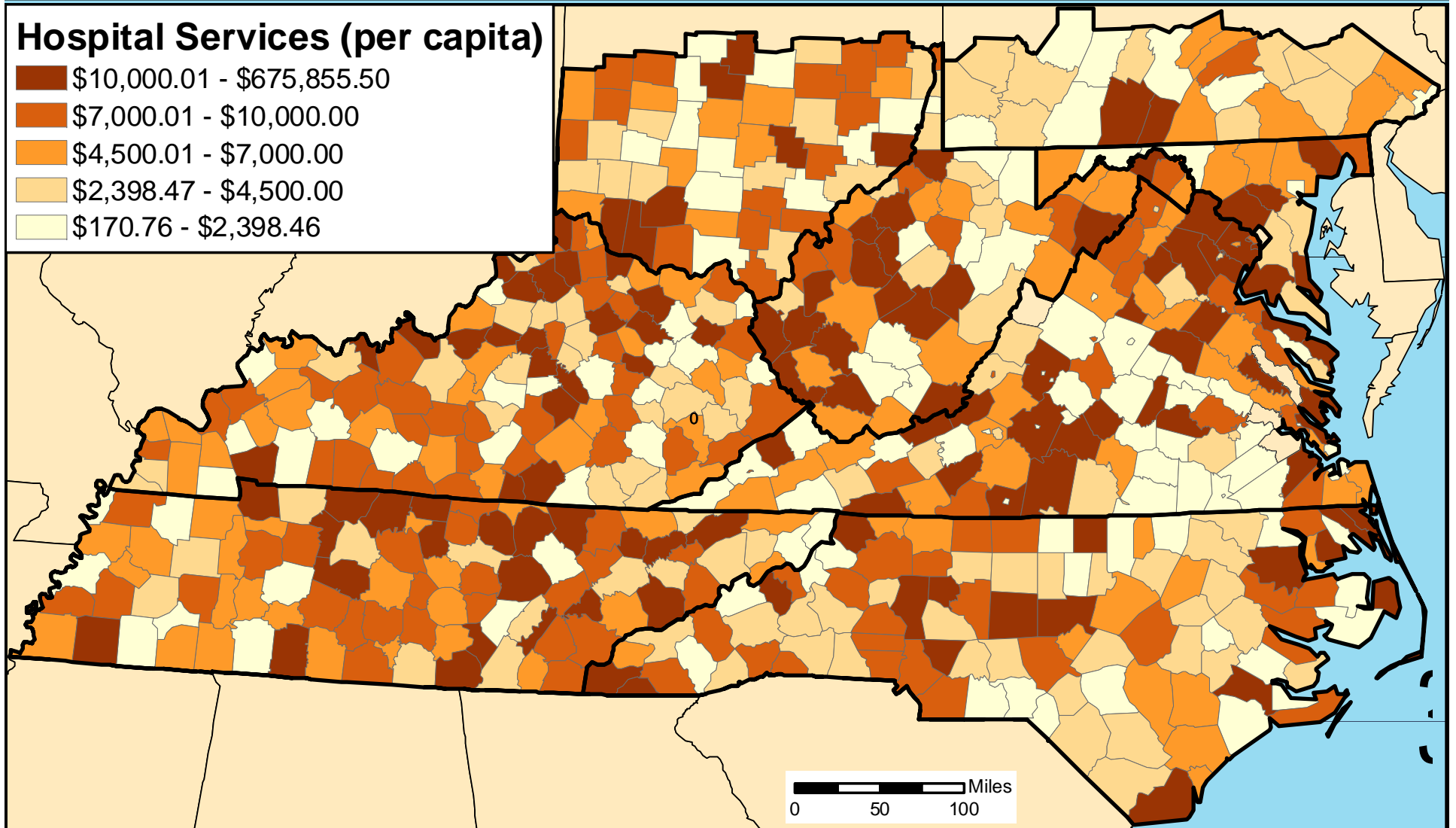
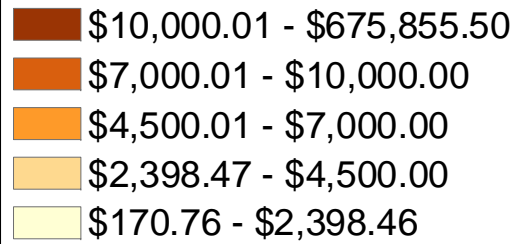
Hospital Spending (% of Total Spending)

% Hospital Services



Hospital Spending per Household

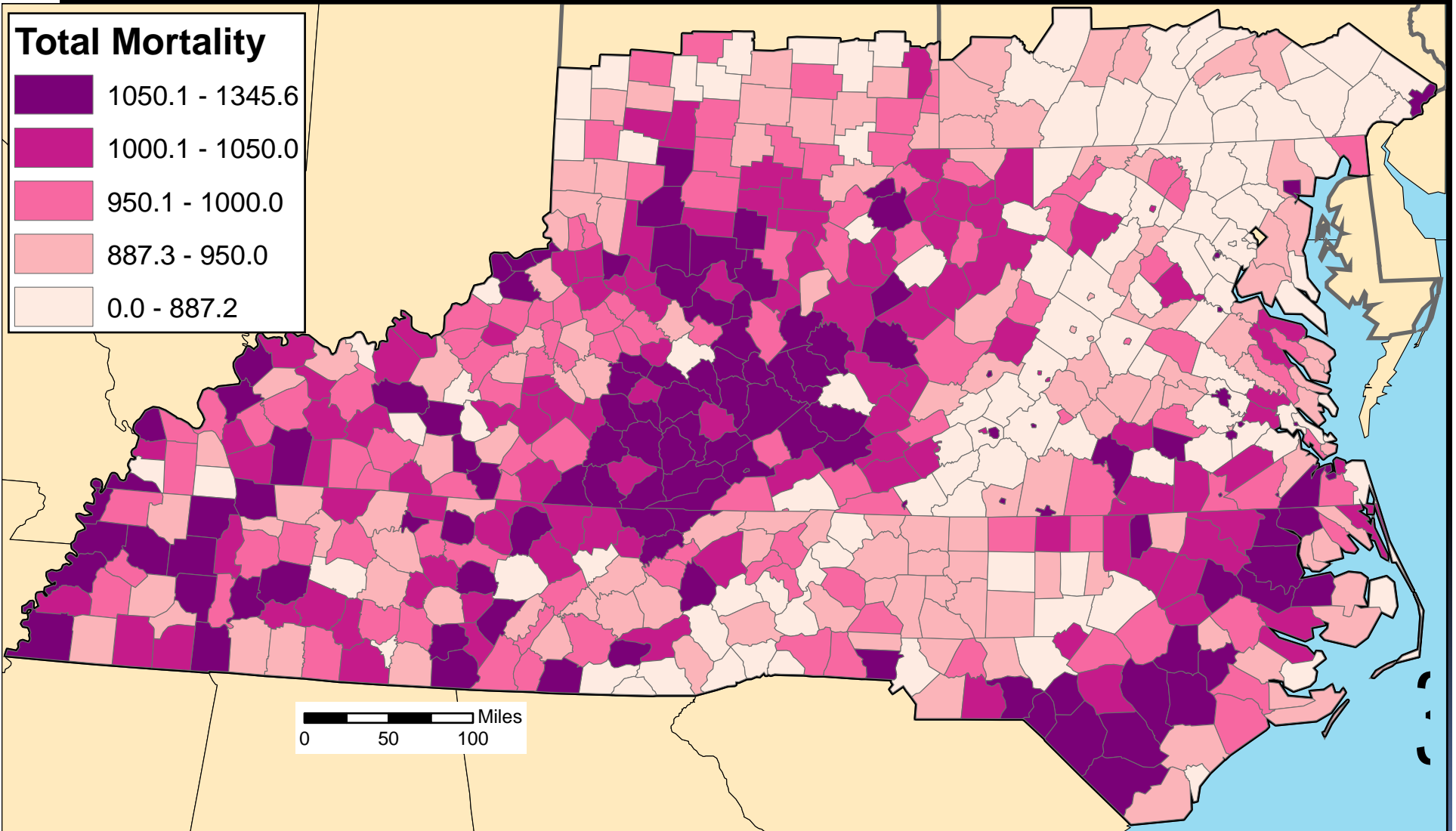
Hospital Services (per capita)



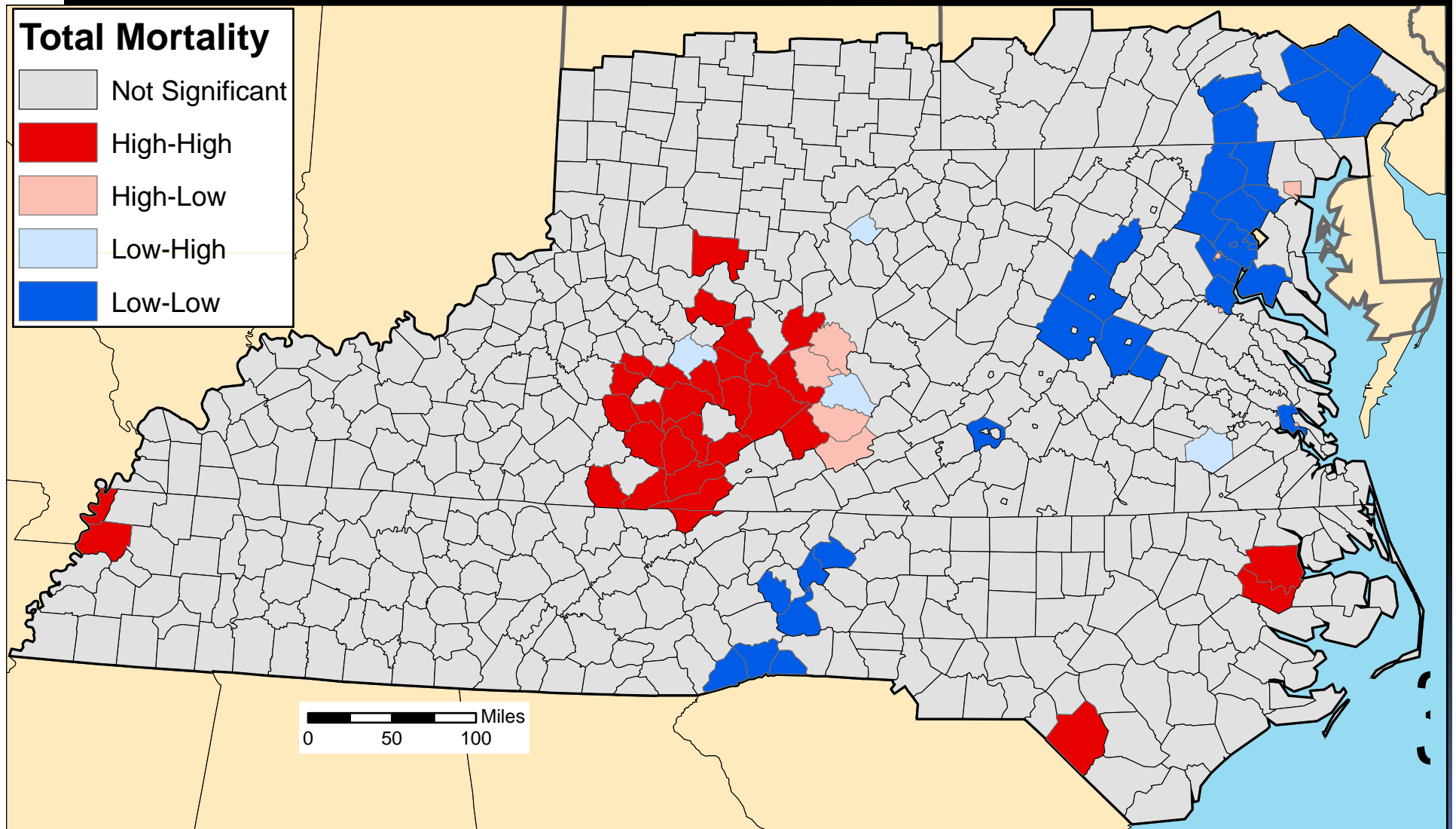
Major Causes of Death

- Total
- Diseases of Heart
- Total Cancers
- COPD

Mortality Rates for All Causes Across Central

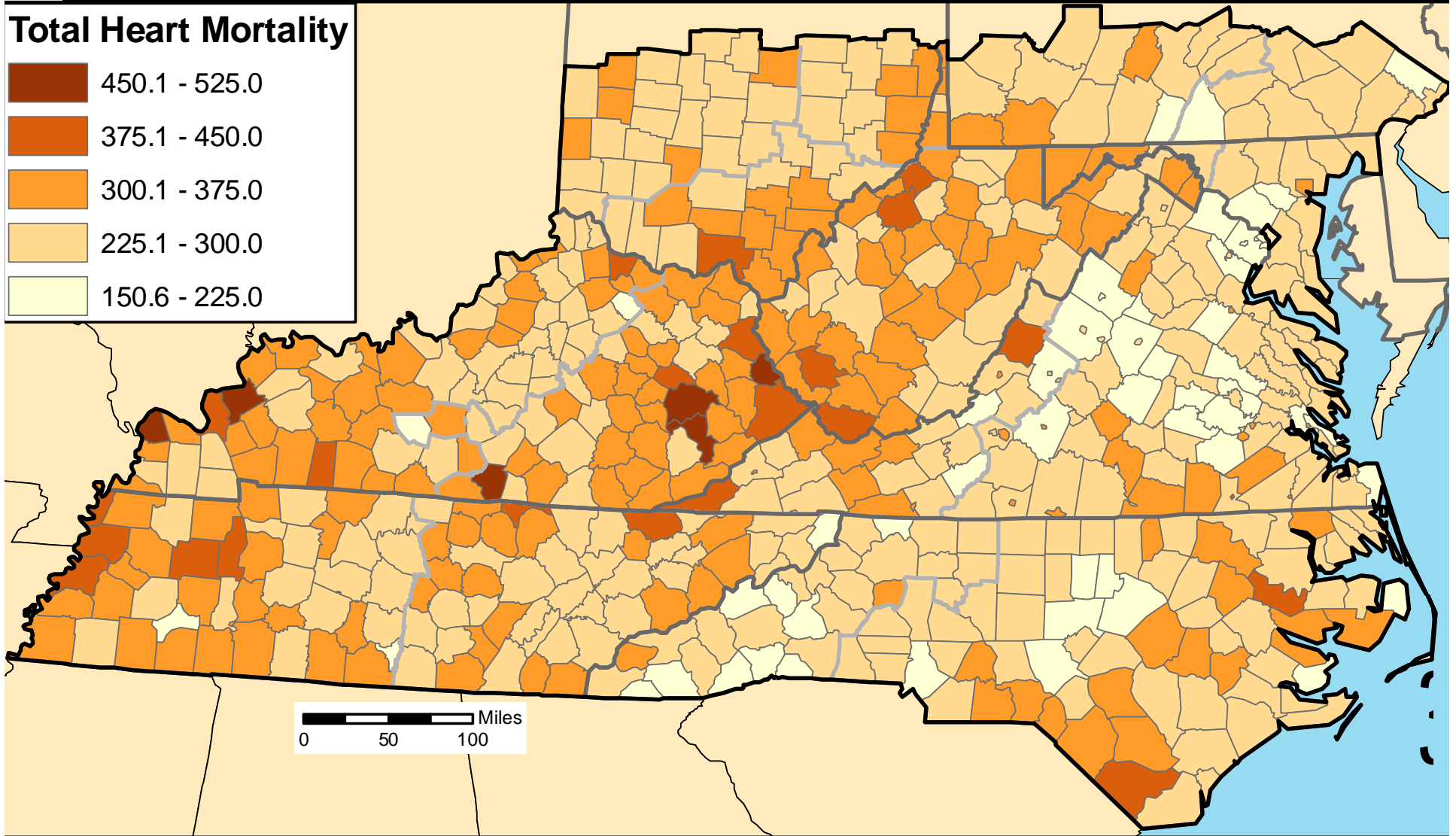
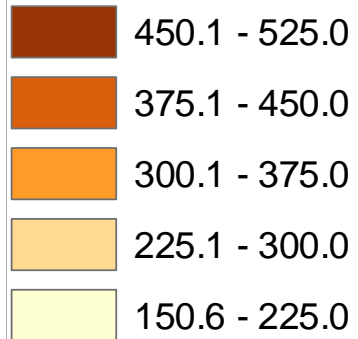


LISA Cluster Map of Total Mortality



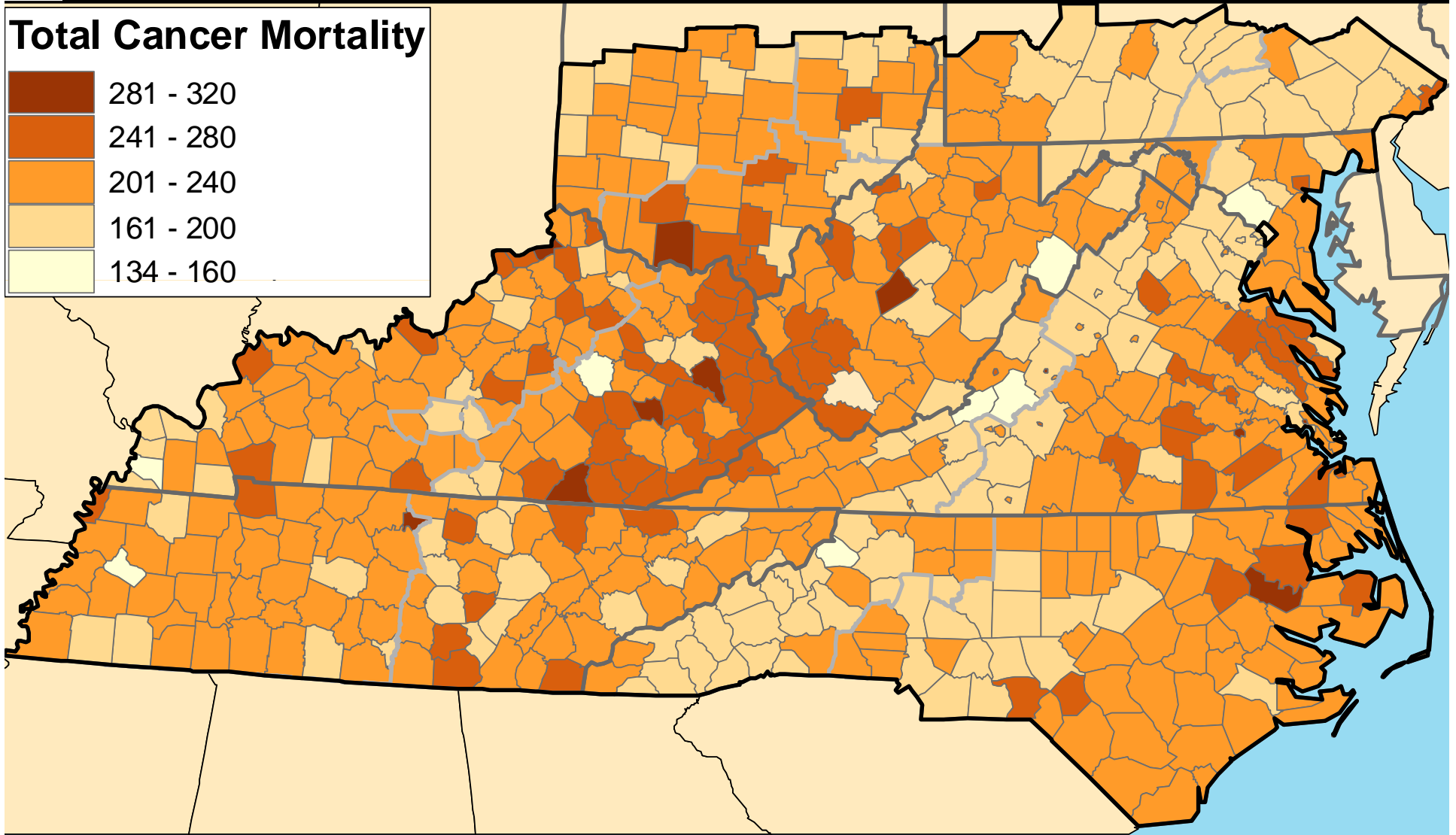
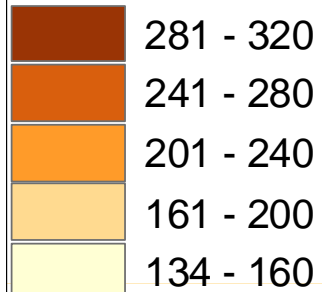
Mortality Due to Diseases of Heart

Total Heart Mortality



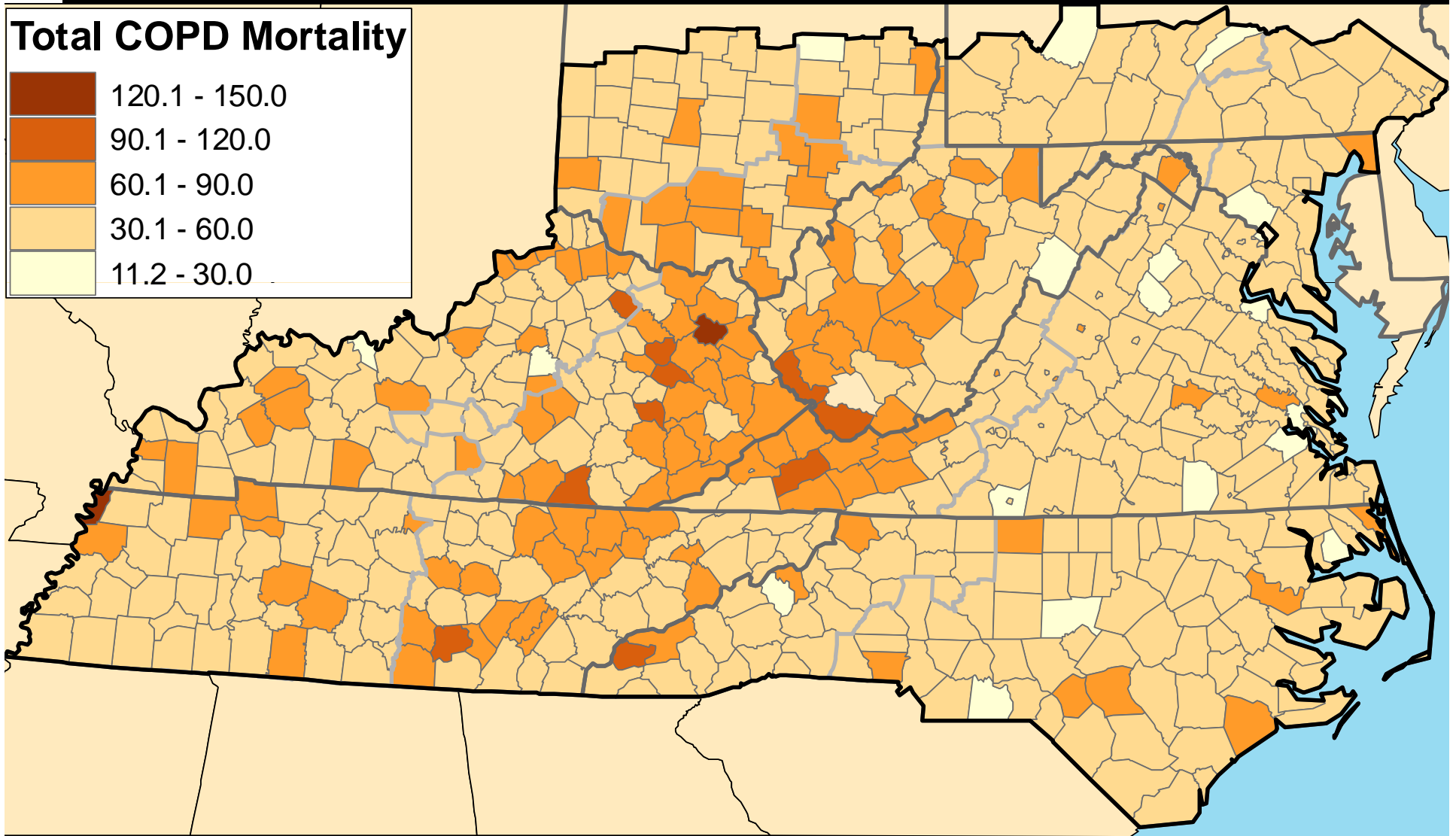
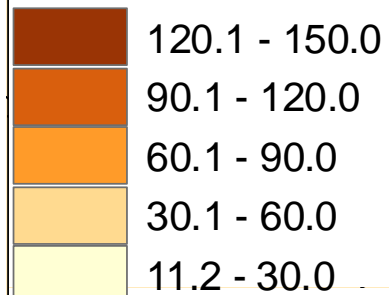
Mortality Due to Cancer

Total Cancer Mortality



Mortality Due to COPD

Total COPD Mortality



ESDA: Moran's I (vs. Total Mortality)

Variable	Moran's I		Bivariate Moran's I	
Total Mortality	0.2544	***	N/A	N/A
Health Spending (PH)	0.3819	***	0.2528	***
Education Spending (PH)	0.3349	***	-0.3306	***
Population Density	0.4016	***	-0.2647	***
Median Household Income	0.6082	***	-0.3224	***
Educational Attainment	0.4189	***	-0.2553	***
% Employed in Health Care	0.2312	***	0.1255	***
Unemployment Rate	0.3474	***	0.2962	***

ESDA: Summary of Results

- As _____ increases mortality increases
 - Health spending as % of household spending
 - % employed in health care
 - Unemployment
- As _____ increases mortality decreases
 - Education spending as % of household spending
 - Population density
 - Median Household income
 - Educational attainment

ESDA: Consistent Spatial Patterns

- High deprivation
 - Eastern Kentucky
 - West Virginia
 - Coastal North Carolina
 - Coastal southeastern Virginia
- Low Deprivation
 - All along eastern edge of Appalachia
 - Pennsylvania & northeastern study area

OLS Model: Total Mortality

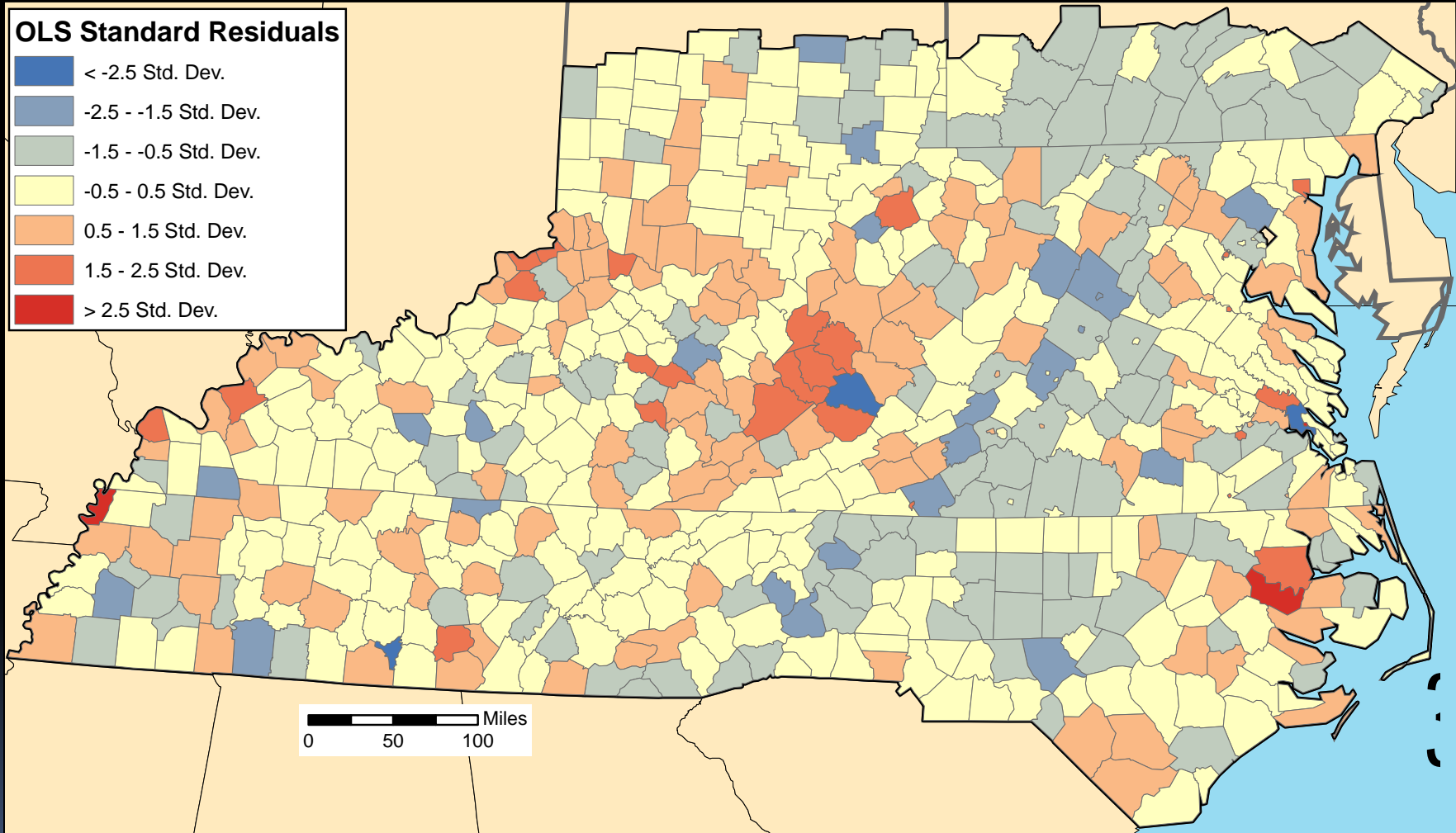
Number of Observations:	597	Number of Variables:	10
Degrees of Freedom:	587	Akaike's Information Criterion (AIC):	7106.958
Multiple R-Squared:	0.388929	Adjusted R-Squared:	0.3796

OLS Model: Total Mortality

Variable	Coefficient	StdError	t-Statistic	Probability	
Intercept	916.169299	83.752692	10.938983	0.000000	***
Health Spending as % of Total Spending	-5.292712	8.096655	-0.653691	0.513564	
Educational Spending as % of Total Spending	93.157677	20.847958	4.468432	0.000012	***
Median Household Income	-0.003658	0.000633	-5.777821	0.000000	***
Mean Household Size	80.018813	30.055596	2.662360	0.007967	**
Diversity Index	0.473557	0.227736	2.079414	0.038000	*
% w/ High School Diploma	-2.726191	0.685269	-3.978280	0.000086	***
Unemployment Rate	14.253831	2.132368	6.684509	0.000000	***

Note: * $p < 0.1$, ** $p < 0.01$, *** $p < 0.001$

OLS Model Standard Residuals



OLS Model 1: Diagnostics for Spatial Dependence

TEST	MI/DF	VALUE	PROB
Moran's I (error)	0.086977	N/A	N/A
Lagrange Multiplier (lag)	1	9.58570650	0.0019610
Robust LM (lag)	1	0.2699404	0.6033718
Lagrange Multiplier (error)	1	11.0669908	0.0008788
Robust LM (error)	1	1.75122470	0.1857228
Lagrange Multiplier (SARMA)	2	11.33693120	0.0034532

Spatial Error Model Results

R-squared:	0.405444	R-squared (BUSE):	-
Sq. Correlation:	-	Log likelihood:	-3538.12
Sigma-square:	8149.206	Akaike info criterion:	7092.24
S.E of regression:	90.273	Schwarz criterion:	7127.38

Spatial Error Model

Variable	Coefficient	Std.Error	z-value	Probability	
CONSTANT	991.1399	89.72619	11.04627	0.0000000	***
HESPPRHS	-4.173309	8.347418	-0.4999521	0.6171088	
EDSPPRCSP	107.1212	20.86821	5.133226	0.0000003	***
MEDHINCCY	-0.0036941	0.0006658	-5.548272	0.0000000	***
AVGHHSZ_CY	54.83352	31.79137	1.724793	0.0845647	*
DIVINDX_CY	0.5394198	0.2622922	2.056561	0.0397284	*
PRHIGHSCHD	-3.159786	0.7313682	-4.320377	0.0000156	***
UNEMPRATE	12.72366	2.213794	5.747444	0.0000000	***
LAMBDA	0.2200312	0.0585949	3.755123	0.0001733	***

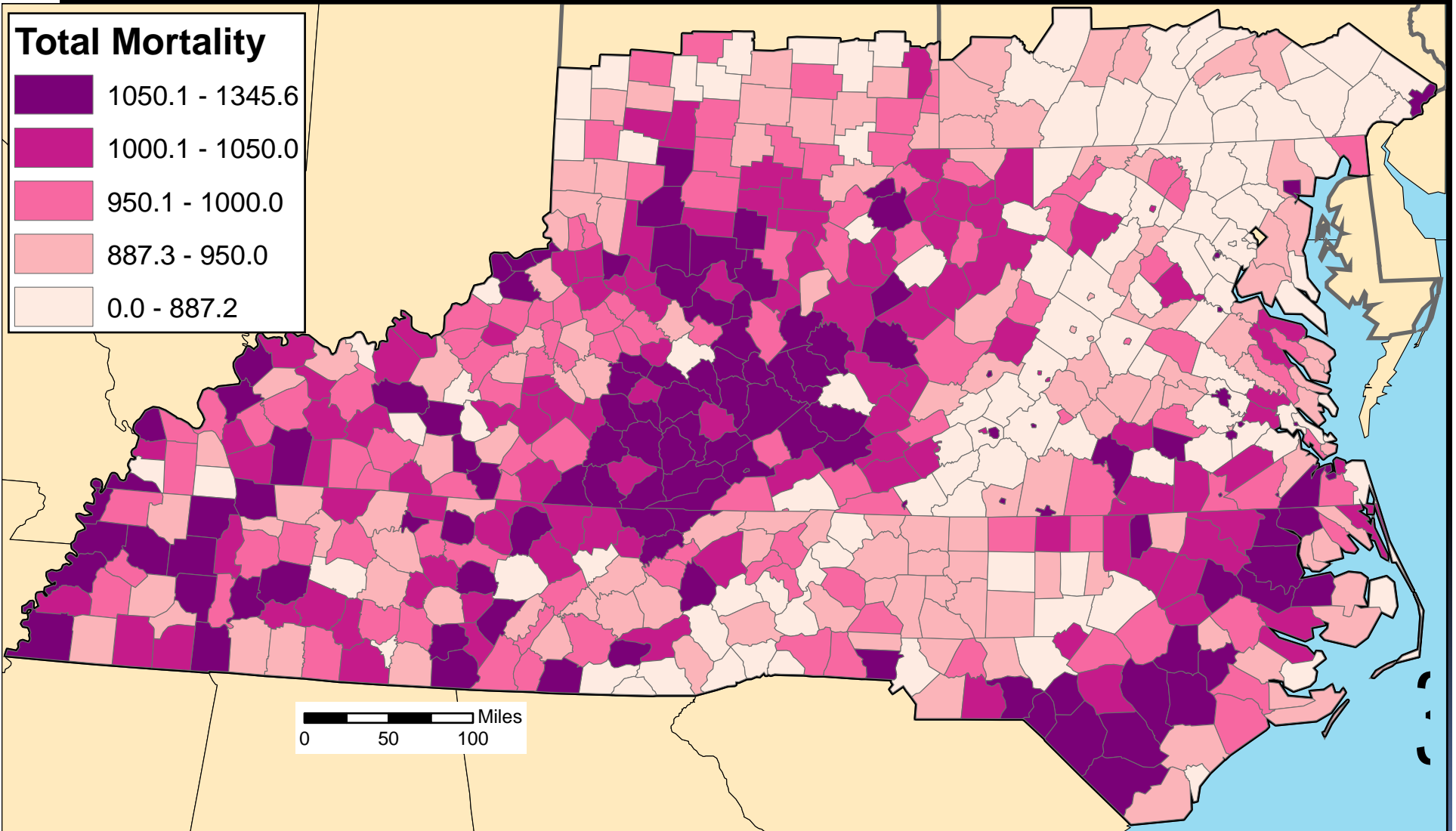
Comparison of OLS vs. Spatial Error Model

OLS		Spatial Error	
Adjusted R-Squared:	0.3796	R-squared:	0.405444
Akaike's Information Criterion (AIC):	7106.958	Akaike info criterion:	7092.24

Comparison of OLS vs. Spatial Error Model

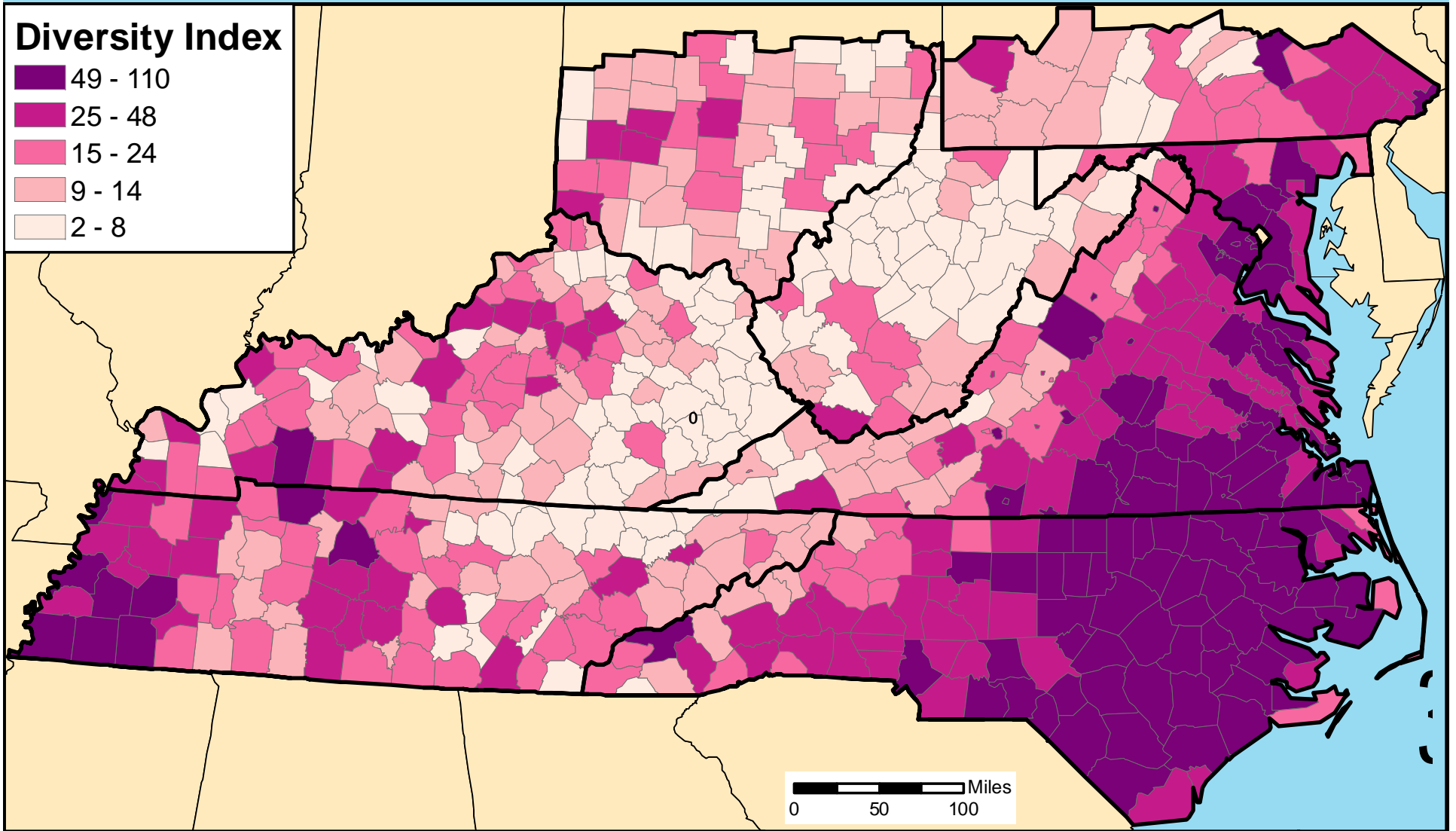
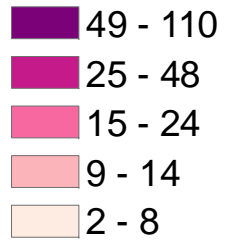
OLS	Coefficient		Spatial Error	
Intercept	916.169299	***	991.1399	***
Health Spending as % of Total Spending	-5.292712		-4.173309	
Educational Spending as % of Total Spending	93.157677	***	107.1212	***
Median Household Income	-0.003658	***	-0.0036941	***
Mean Household Size	80.018813	**	54.83352	*
Diversity Index	0.473557	*	0.5394198	*
% w/ High School Diploma	-2.726191	***	-3.159786	***
Unemployment Rate	14.253831	***	12.72366	***
LAMBDA	n/a		0.2200312	***

Mortality Rates for All Causes Across Central



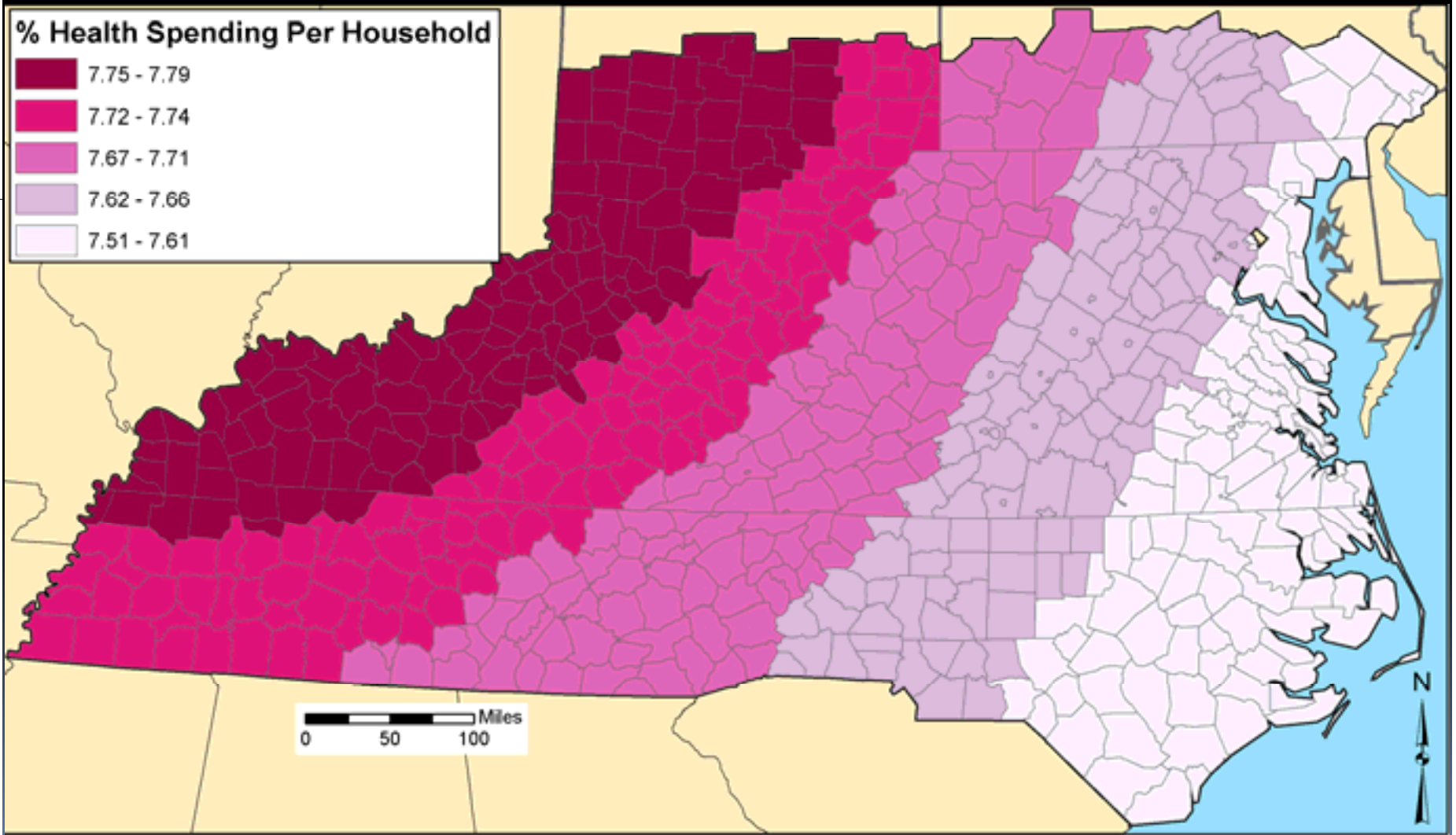
Diversity Index

Diversity Index



Why not use GWR?

- Model specification problems (multicollinearity)



Regression: Summary of Results

- As _____ increases mortality increases
 - Education spending
 - Unemployment
 - Mean Household Size
 - Diversity
- As _____ increases mortality decreases
 - Health spending
 - Median Household income
 - Educational attainment

Regression: Consistent Spatial Patterns

- High deprivation
 - Eastern Kentucky
 - West Virginia
 - Coastal North Carolina
 - Coastal southeastern Virginia
- Low Deprivation
 - All along eastern edge of Appalachia
 - Pennsylvania & northeastern study area

Conflicts between ESDA & Regression Analyses

- Changes in the direction of effects of
 - Health Spending
 - Education Spending

Major Patterns: Deprivation, Mortality, & Consumer Spending

- High deprivation ->
 - Low total health care expenditures
 - Low *per capita* health care spending
 - High spending as % of total household spending
 - High spending as % of total spending
- Patterns replicated for
 - Health insurance spending
 - Hospital spending

Key relationships

- Well established
 - High deprivation -> high mortality
- New observations
 - High deprivation ->
 - High health spending as % of total household spending
 - Low total health spending
 - Low *per capita* spending

Major Regional Patterns

- Eastern Kentucky's situation
 - Highest deprivation
 - Highest mortality rates
 - Highest health spending as % of total spending
 - Lowest total & *per capita* health spending
- West Virginia – better than eastern KY
 - Lower deprivation
 - Lower mortality rates
 - Higher total & *per capita* health spending

Results Summary

- High degree of geographical variability
- Less geographical clustering than expected
- Many meaningful patterns
 - Urban vs. rural
 - Deprivation, mortality, & health spending
 - Eastern Kentucky – low health spending fails
 - West Virginia – high health spending pays off

Thank You

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kcgero.org

Institute for Regional Analysis
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Center of Excellence, MSU

A Kentucky Program of Distinction

<http://irapp.morehead-st.edu>

