A Spatial Analysis of Demographic and Economic Characteristics

Penn State Scranton area

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Penn State Data User Conference

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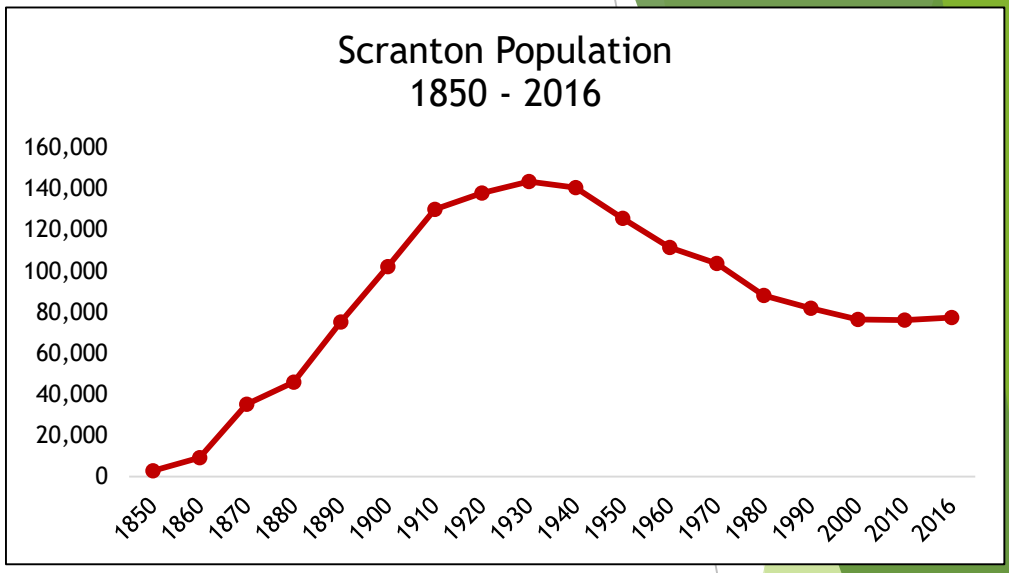
Scranton Area Historical Context

- **1800s through 1930s**
  - Coal economy
  - Demographic growth
  - Urban growth
- **1940s through 2000s**
  - Manufacturing economy
  - Demographic decline
  - Urban decline
- **2000s to present**
  - Diversified economy
  - Demographic stabilization
  - Downtown revitalization



Source: Statistical Atlas, 2015.

Penn State Scranton

- Served as an Extension site in the 1920s
- Formally established as a Commonwealth Campus in 1968
- Present-day
  - 1,029 students
    - 45% are first in their families to attend college
    - 33% are low-income (Penn State, 2015)
  - 253 employees
    - Full-time and part-time
  - Degree programs
    - Baccalaureate: Biology, Business, Corporate Communication, English, Human Development and Family Studies, Information Sciences and Technology, Letters, Arts and Sciences, Nursing, Nursing RN to B.S., Project and Supply Chain Management, Psychology, Science

Research Questions

1. What are the demographic and economic characteristics of Penn State Scranton area?

Methods:
- Descriptive Statistics
- ESDA
  - Global Moran's *I*
  - LISA

2. Do the relationships between demographic and economic variables vary by proximity to campus?

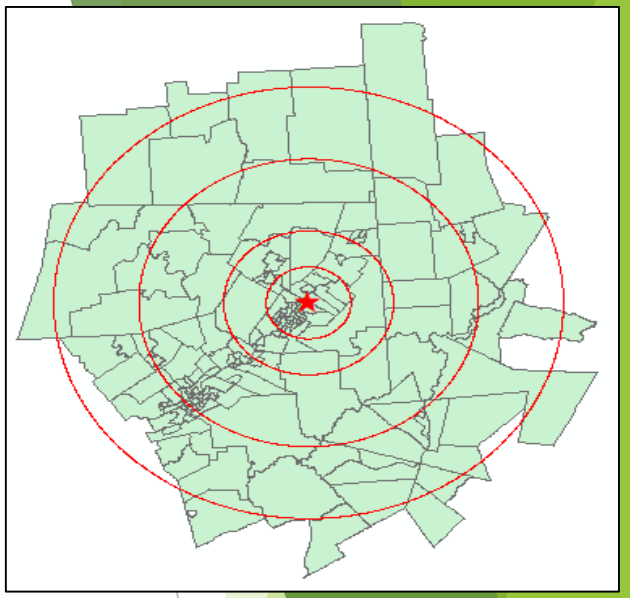
Methods:
- OLS regression

3. What are demographic and economic determinants of income in Penn State Scranton area?

Methods:
- Weighting scheme
- Spatial diagnostics
- Spatial error model

Data & Tools

- Source: Census Bureau
  - Tract geographic coordinates: TIGER/line shapefiles
  - Demographic and economic variables: American Community Survey (ACS) Five-Year Estimates (2012 – 2016)
- Geographic area
  - Census tracts within a 30 mile radius of Penn State Scranton campus
  - N = 175 tracts
- Software:
  - ArcGIS, GeoDa, and GeoDa Space
- Outcome Variable
  - Median household income
- Independent Variables:
  - Percent with a bachelor's degree or higher
  - Median housing costs
  - Percent renter occupied
  - Tested but not statistically significant: distance to campus (continuous and dichotomous variable), income inequality index, median age, racial composition, unemployment rate, percent living in same house the previous year



1. What are the demographic and economic characteristics of Penn State Scranton area?
2. How do the relationships between demographic and economic variables vary by proximity to campus?
3. What are demographic and economic determinants of income in Penn State Scranton area?

Methods

- Exploratory Spatial Data Analysis (ESDA)
  - Global Moran's *I*
  - LISA
- OLS regression
- Weighting scheme
  - Queen 1 contiguity
  - Distance based K6
- Spatial diagnostics
- Spatial Regression
- Qualitative Discussion

We can improve statistical models by identifying and accounting for this spatial relationship.

Basic premise of Spatial Analysis

The values of near or adjacent spatial units influence the value of your unit.

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Exploratory Spatial Data Analysis (ESDA)

Global Moran's *I*

Figure 1. Median Household Income

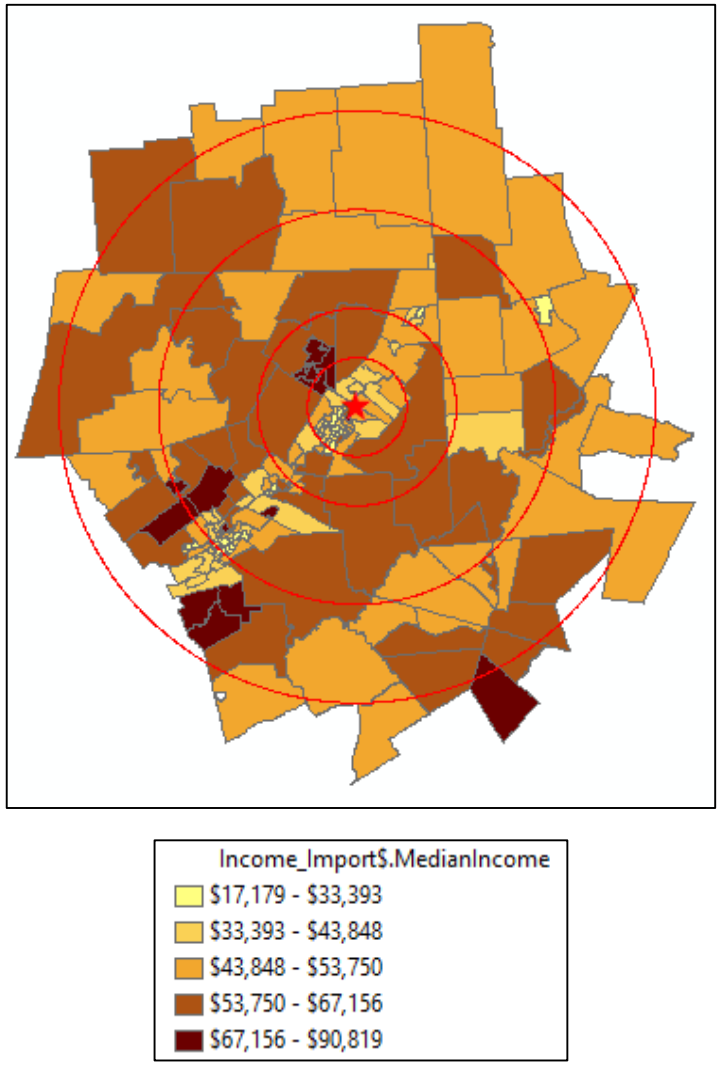


Figure 2. Percent Bachelor's Degree or Higher

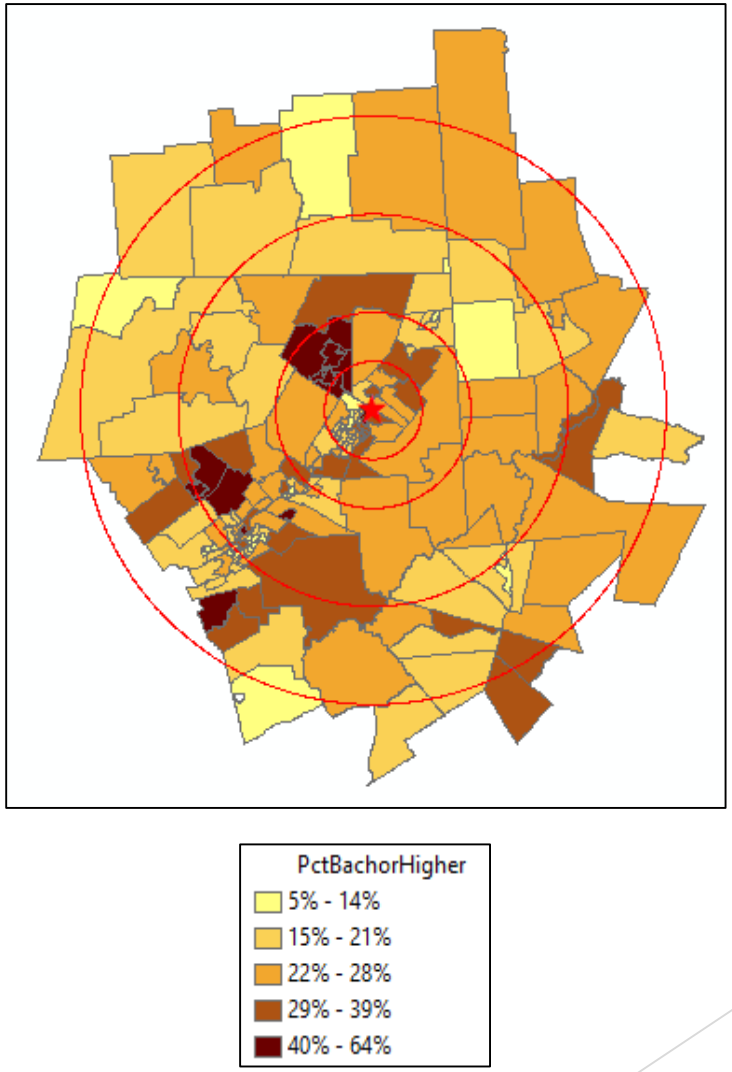


Table 1 Global Moran's *I*

	Global Moran's *I*
Median Household Income	.50***
Median Housing Costs	.58***
% Bachelor's Degree or Higher	.40***
% Renter Occupied	.62***

*** $p \leq .001$

ESDA cont.
Global Moran's *I*

Figure 3. Percent Renter Occupied

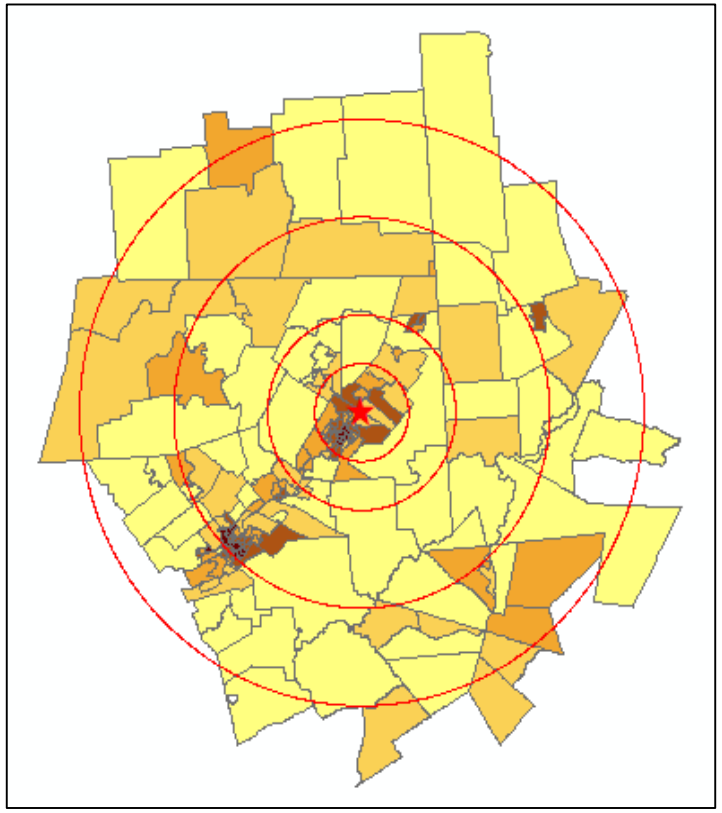
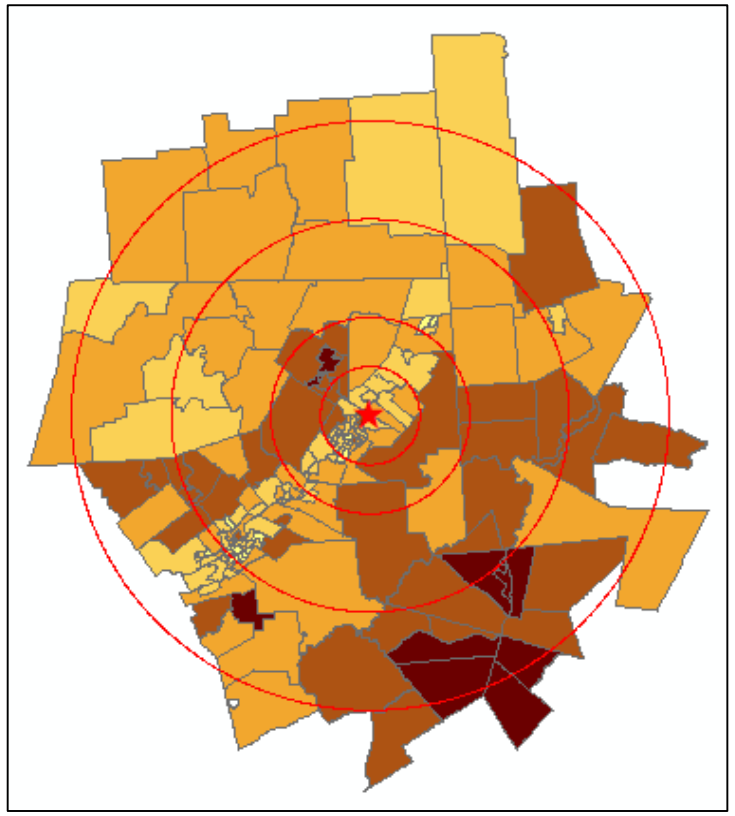


Figure 4. Median Monthly Housing Costs (Rent/Mortgage)



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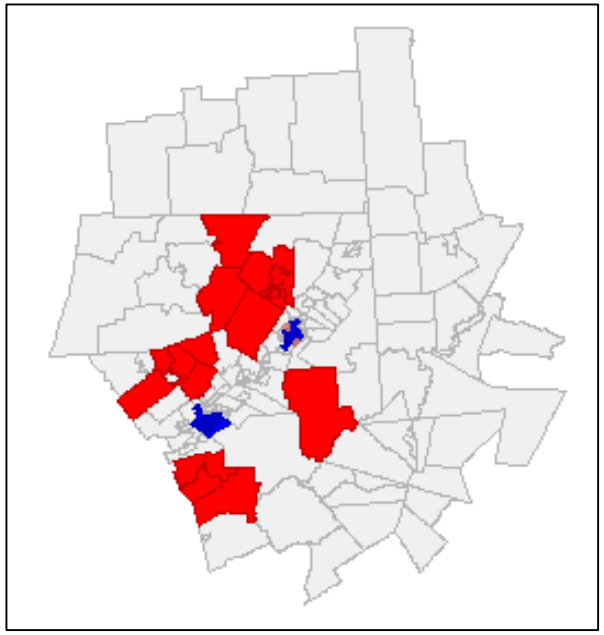
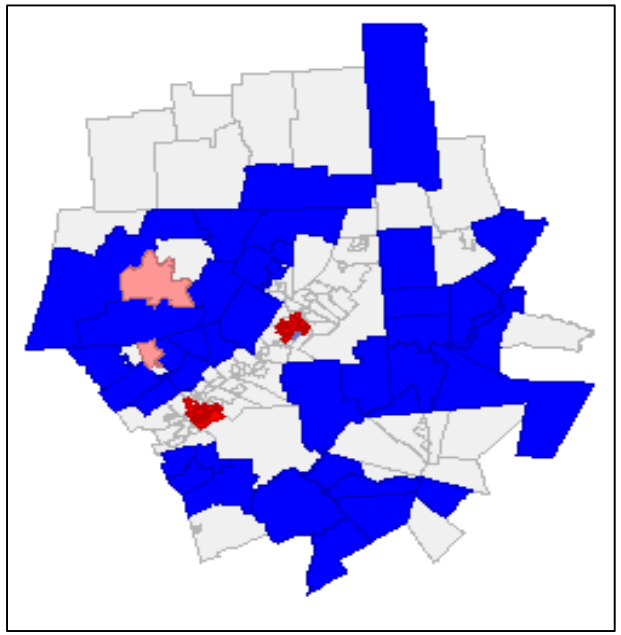
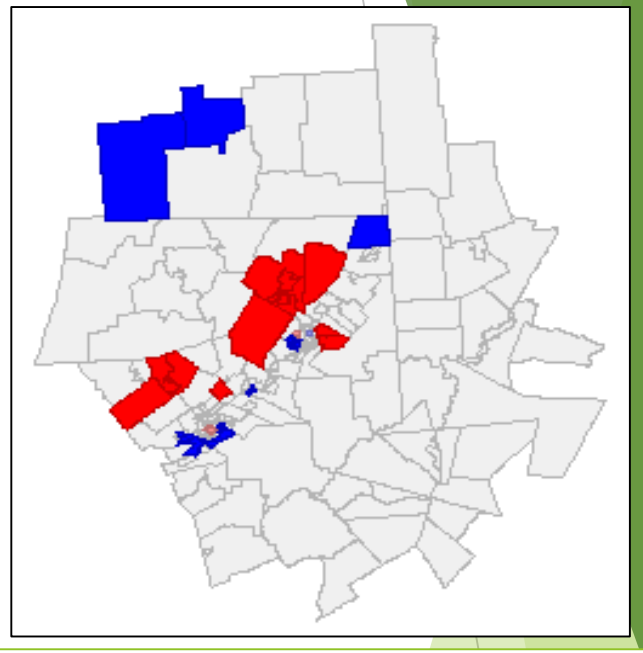
Localized Indicators of Spatial Association (LISA)



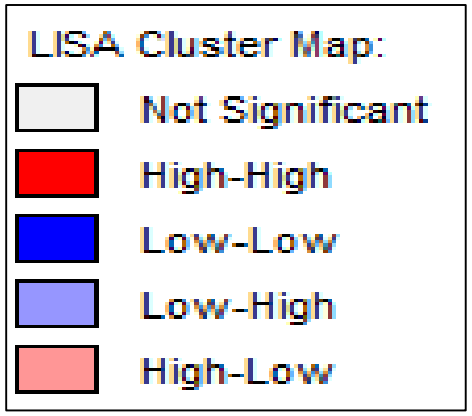
Median Household Income



Percent Renter Occupied



Percent Bachelor's Degree or Higher



High-High = tract with high value is surrounded by neighboring tracts with high values

Low-Low = tract with low value is surrounded by neighboring tracts with low values

Regression

Table 2: OLS regression models predicting median household income

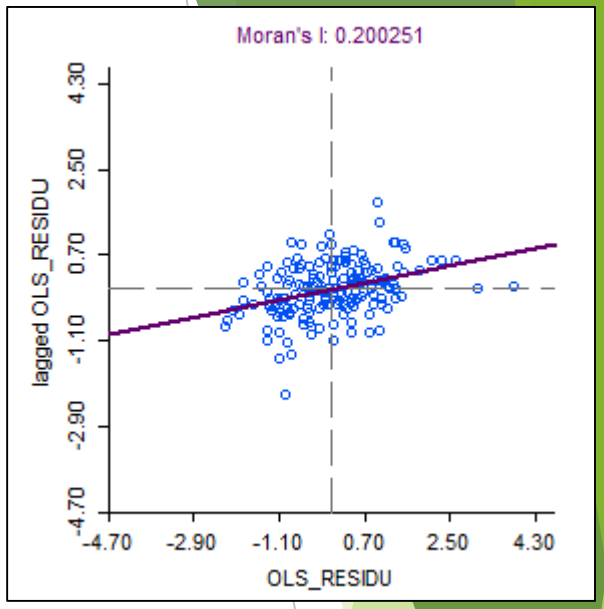
	Model 1		Model 2	
Independent Variable	Coeff	Sd Err	Coeff	Sd Err
Intercept	33228.60***	3413.96	33510.41***	3320.57
Housing Costs	18.87***	3.37	19.13***	3.29
Percent Bachelor's Degree or Higher	553.23***	58.35	547.07***	55.81
Percent Renter Occupied	-41788.70***	3289.38	-41947.00***	3253.56
Distance to Campus (Miles)	24.60	66.06		
R-squared	.80		.80	
Akaike information criterion (AIC)	3559.86		3558.00	
Diagnostics				
Lagrange Multiplier (error)	17.82***		18.22**	
Robust LM (error)	11.45***		11.75***	
Lagrange Multiplier (lag)	6.37**		6.47**	
Robust LM (lag)	0.00		0.00	

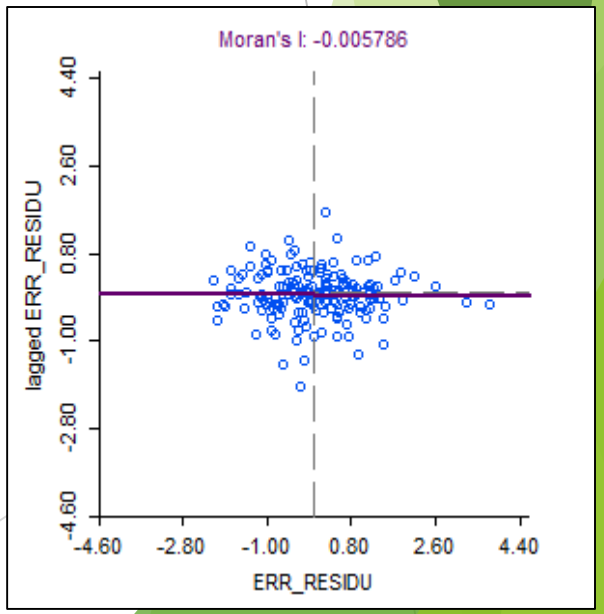
** $p \leq .01$; *** $p \leq .001$

Table 2: Spatial Error model predicting median household income

	Model 3	
Independent Variable	Coeff	Std Err
Intercept	30206.60***	3706.80
Housing Costs	24.66***	3.71
Percent Bachelor's Degree or Higher	479.84***	60.26
Percent Renter Occupied	-40945.00***	3736.56
Spatially-weighted error term (Lambda)	0.45***	0.09
R-squared	.83	
Akaike information criterion	3540.76	

*** $p \leq .001$





Conclusion

1. What are the demographic and economic characteristics of Penn State Scranton area?

- As indicated by the Moran's *I* statistic and LISA, the outcome and independent variables are all spatially structured at the global and local levels.
- Spatial patterns consistent with renter's market in immediate downtown proximity with lower home values and lower incomes. Higher incomes and home values in a cluster five to ten mile southwest of campus. Housing developments along I-81 corridor, with wealth clustering in elevated heights on both sides the valley.

2. How do the relationships between demographic and economic variables vary by proximity to campus?

- The relationship between geographic proximity to Penn State Scranton and median household income was not found to be statistically significant in this analysis.
- (Doesn't mean it doesn't exist!)

3. What demographic and economic variables are determinants of income in Penn State Scranton?

- Percent bachelor's degree or higher, median housing costs, and percent renter occupied describe 83% of the variation in median household income at the tract level.
- The spatial error model minimized spatial autocorrelation in the residuals and provided a modest improvement in model fit.

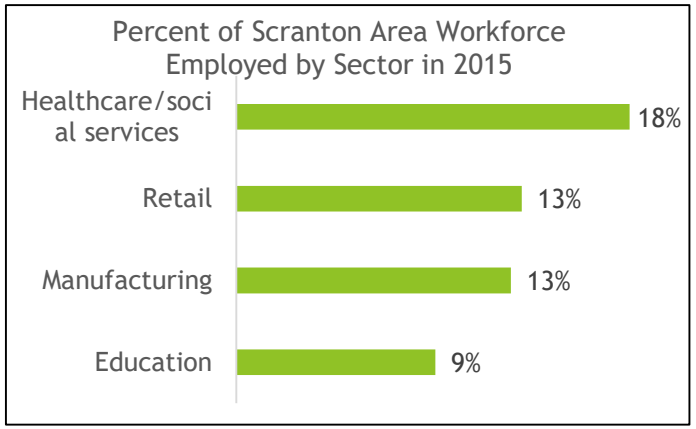
Extensions

- Exploring localized impact
  - Areal units in ascending order: Block → Tract → County → State → Nation
  - Tract-level data
- Cross-referencing publicly available data with University data
  - Census and ACS data
  - Employee and student address data
  - Economic and demographic “hot spots”
- Creating a quasi-comparison group
- Using mixed methods
  - Quantitative and qualitative methods

Penn State Scranton

- Challenges in higher education
  - Declining demography and enrollment pool in traditional markets
  - Declining policy support
  - Long-term economic viability
- Survival strategies
  - Expanding enrollment market
    - Non-traditional students
  - Tailoring program offerings to local labor market needs
    - Healthcare: Nursing and Biology
    - Social Services: Human Development & Family Studies
    - Manufacturing: Project and Supply Chain Management

"Degrees we offer are degrees we can use within this community."



Dr. Janet Melnick to present research at local aging conference

February 28, 2013

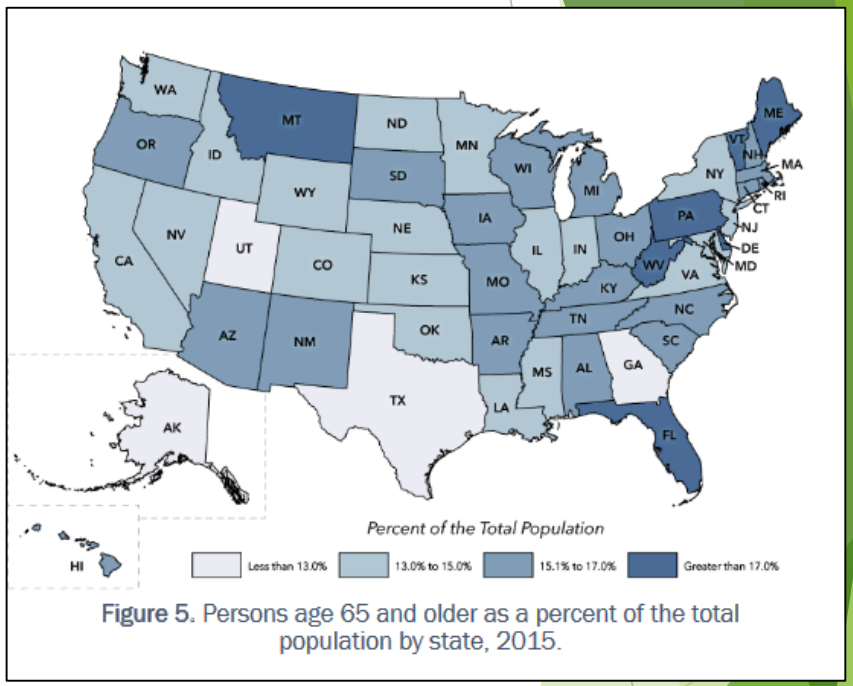


Figure 5. Persons age 65 and older as a percent of the total population by state, 2015.

Source: Penn State Data Center

Local professors to study alternatives to nursing homes in rural Pennsylvania

January 26, 2012

Questions and Comments