Housing Metrics Methods Development
GIS Technical Analysis

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Project Description

- Project goal: Methodology for aggregating rural census tracts to enable regional analysis of housing data
  - Issue: Census socio-economic variable estimates (from ACS) are not reliable for non-urban tracts
  - Approach: Exploratory spatial data analysis
- Result: Clustered census tracts by state for further analysis

Clustering work

- Approach
  - Develop tract-based housing and socio-economic variables (ACS, GIS)
  - Use spatial clustering to group tracts of interest
  - Present results as maps, tables
- Methods: Spatially constrained multivariate clustering (ArcGIS Pro)

Clustering work (2)

- Details
  - Spatially constrained: Location matters (tracts in same cluster will be contiguous)
  - Multivariate: Groups tracts based on values for selected variables
- 35 different variables quantified for each tract
  - Housing, socio-economic, GIS-derived
  - Correlation analysis used to eliminate redundancy in variables
  - 10 variables used in final clustering

Tract Variables

N=35 variables developed

Variables quantified for each tract

<mark>Highlighted variables (n=10)</mark> used for final clustering (not dependent on tract size/population, not highly correlated with one another)

| Variable	Description
HH	total households
POP25	population over age 25
HUNITS	total housing units
OCCU	occupied housing units
OWNU	owner occupied housing units
RENTU	renter occupied housing units
HHINC	median household income
HHINC_O	median household income, owners
HHINC_R	median household income, renters
MEDDOL	median dollars (value)
MEDGRO	median (dollars) gross rent
MEDM	median (dollars) with mortgage
MEDNOM	median (dollars) without mortgage
WITHM30	30.0 to 34.9 percent_WithM
WITHM35	35.0 percent or more_WithM
PCBM	% Cost Burden Owner with a mortgage
PCB30	30.0 to 34.9 percent_Rent
PCB35	35.0 percent or more_Rent
PCBR	% Cost Burden Renter
NLCD_PFOR	Percent (0-100) forested in tract, from 2019 NLCD forested land cover categories
NLCD_PDEV	Percent (0-100) developed in tract, from 2019 NLCD developed land cover categories
NLCD_PWAT	Percent (0-100) water in tract, from 2019 NLCD category 11 open water only
UA_PERC	Percent (0-100) urbanized area in tract, from 2010 Census urbanized areas
ACSPOP_19	Estimated population in tract, 2019 ACS 5-year estimates
AreaSqMi	Area of tract in square miles (calculated by GIS)
PopDen_19	Estimated population density (2019 population divided by area in sq miles)
Q75_UA	0 or 1. Is tract over 75th percentile in urbanized area relative to other tracts
Q75_NLCDDE	0 or 1. Is tract over 75th percentile in developed area relative to other tracts
Q75_PopDen	0 or 1. Is tract over 75th percentile in population density relative to other tracts
PUBLIC_PCT	Percent (0-100) public land in the tract as defined by US CBI
COMMUTERS	number of commuters (ACS journey to work data 2014-2019)
PCT_COMM90	percent of commuters traveling over 90 minutes to work (ACS 2014-2019)
PCT_COMM60	percent of commuters traveling over 60 minutes to work (ACS 2014-2019)
PCT_HHRENT	percent of households renting (calculated by WVU for tracts with data) based on households renting divided by total occupied households
PCT_HHOCC	percent of households occupied (calculated by WVU for tracts with data), based on total occupied households divided by total households

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Study area: Tracts

- Clustering performed by state
- Excluded tracts within metropolitan or micropolitan statistical areas

State	# Tracts (total in ARC)	# Tracts included
Alabama	728	64
Kentucky	318	170
Tennessee	646	59
Virginia	185	76
West Virginia	484	100
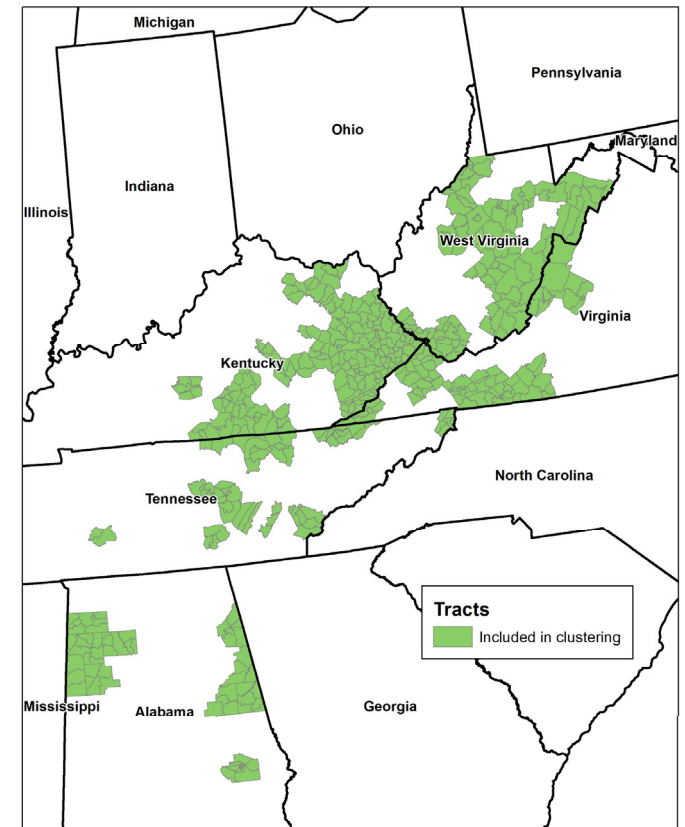
Clustering methods

- Clustering model iterations – by state
  - Run model with different variables, examine R^2 values
  - For each state, determine best model for final clustering, based on which variables were most useful

- Final clusters – adjustments
  - Eliminated single-tract (isolated) clusters by merging with adjacent clusters

Isolated cluster
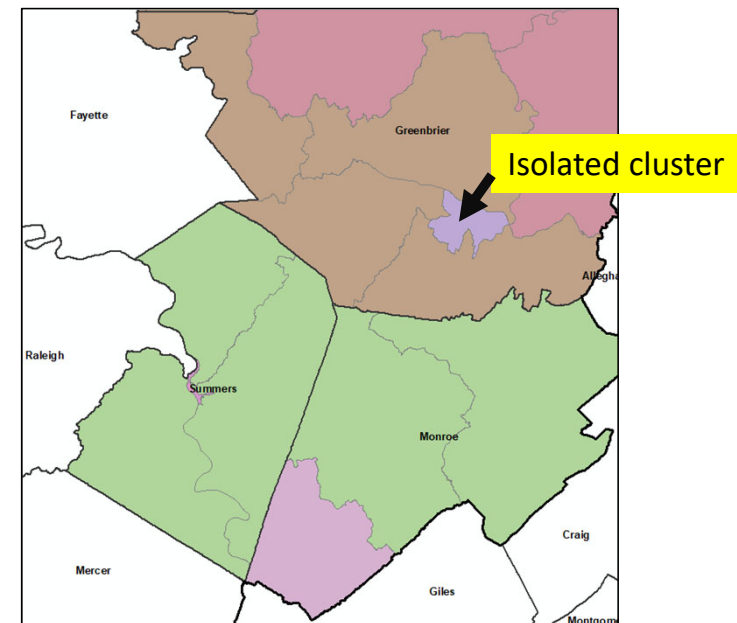
Cluster results: AL

Alabama

Final model for clustering:

Population density, 2019 (R^2 = .906)

% Public land (R^2 = .917)

% Commuting > 60 min (R^2 = .767)

% Occupied households (R^2 = .829)

Final # original clusters: 17

Final # clusters after merging: 10

Alabama Clustering Results
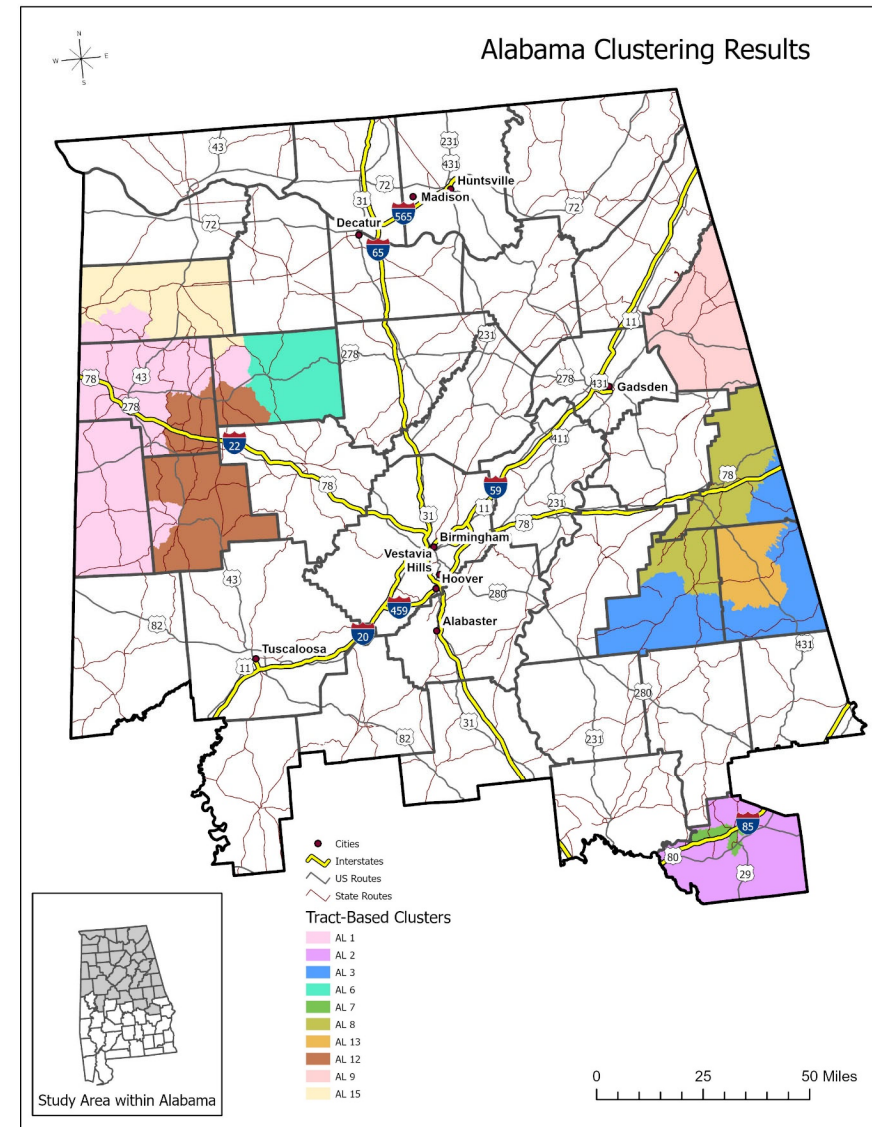
Cluster results: AL

Cluster	Tracts (N)	Households (N)	Housing Units (N)	ACS Population 2019 (Estimate)	Total Area (mi2)
AL 1	12	18,933	23,593	45,980	1413.74
AL 2	7	5,216	6,500	11,541	571.81
AL 3	8	10,628	13,266	27,487	833.05
AL 6	4	5,537	8,607	13,440	430.92
AL 7	5	2,258	3,796	7,167	41.40
AL 8	4	5,947	7,413	15,984	645.28
AL 9	6	10,737	16,579	25,903	599.98
AL 12	7	8,819	10,985	22,037	843.81
AL 13	2	3,005	5,061	7,429	272.82
AL 15	9	12,006	15,181	34,038	568.31

Final Clusters

Final Clusters

Results/Deliverables

- Deliverables
  - Final Technical Report
  - Appendices (Excel)
    1. All tract data - housing
    2. All tract data - GIS
  - Figures (maps, as PDF)
  - Zip archive
- For each state:
  - Map of cluster results
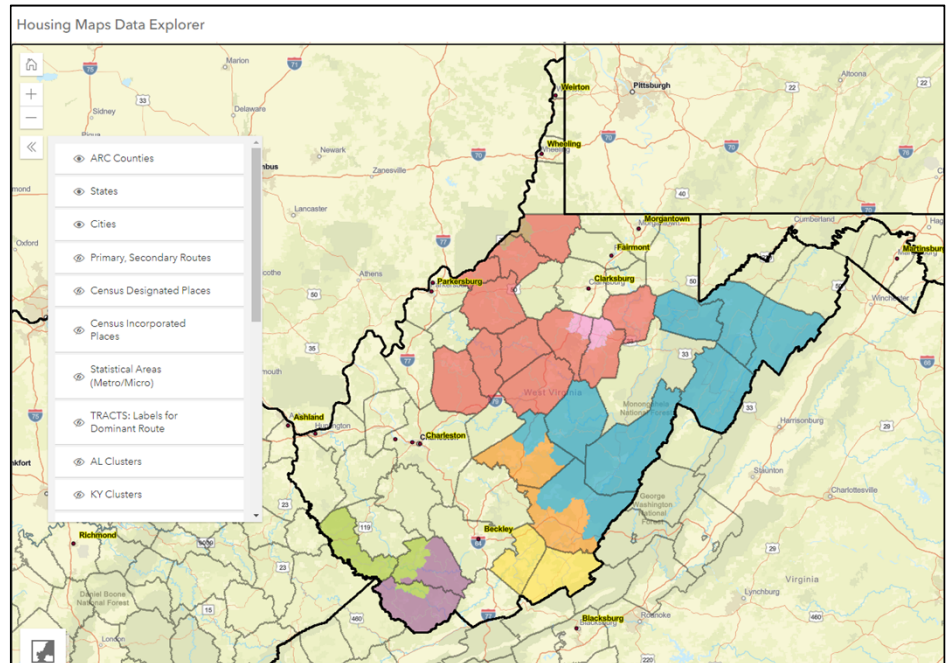 - Cluster summary table

Final report

Sample appendix

Cluster result map for WV

Cluster	Tracts (N)	Households (N)	Housing Units (N)	ACS Population 2019 (Estimate)	Total Area (mi2)
WV 1	11	15,683	19,297	36,612	658.03
WV 2	7	11,284	15,346	26,249	841.37
WV 5	7	9,641	11,173	24,513	170.75
WV 13	4	4,709	5,965	12,591	68.87
WV 20	10	11,230	15,683	27,620	802.66
WV 22	23	29,463	48,061	70,173	4,453.56
WV 26	28	40,713	55,055	105,316	3,678.66
WV 28	10	19,702	24,280	46,300	907.41

Cluster result summary table for WV

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Viewing results on the web

- Housing Maps Data Explorer (ArcGIS Online web map app)

- No password or account required

- Link: https://arcg.is/1OLSrn

- Layers included:
  - Cluster results by state (merged final clusters)
  - Additional reference layers

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Thank you!

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