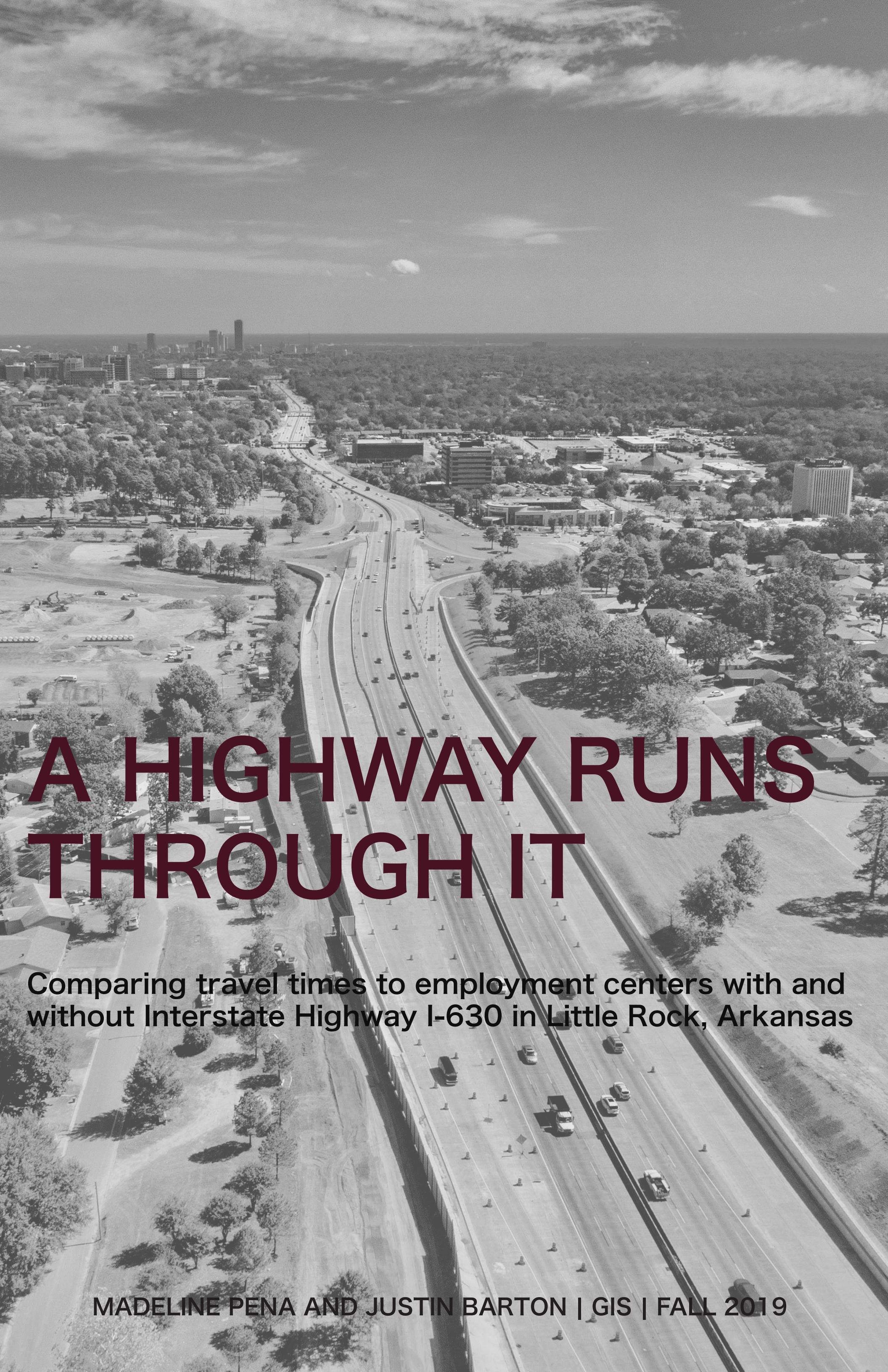


A HIGHWAY RUNS THROUGH IT

An aerial photograph of Interstate Highway I-630 in Little Rock, Arkansas. The highway is a six-lane divided road with a concrete barrier in the center. It curves from the bottom right towards the top left. The surrounding area is a mix of green trees, residential houses, and larger commercial buildings. In the far distance, the city skyline of Little Rock is visible under a cloudy sky.

Comparing travel times to employment centers with and without Interstate Highway I-630 in Little Rock, Arkansas

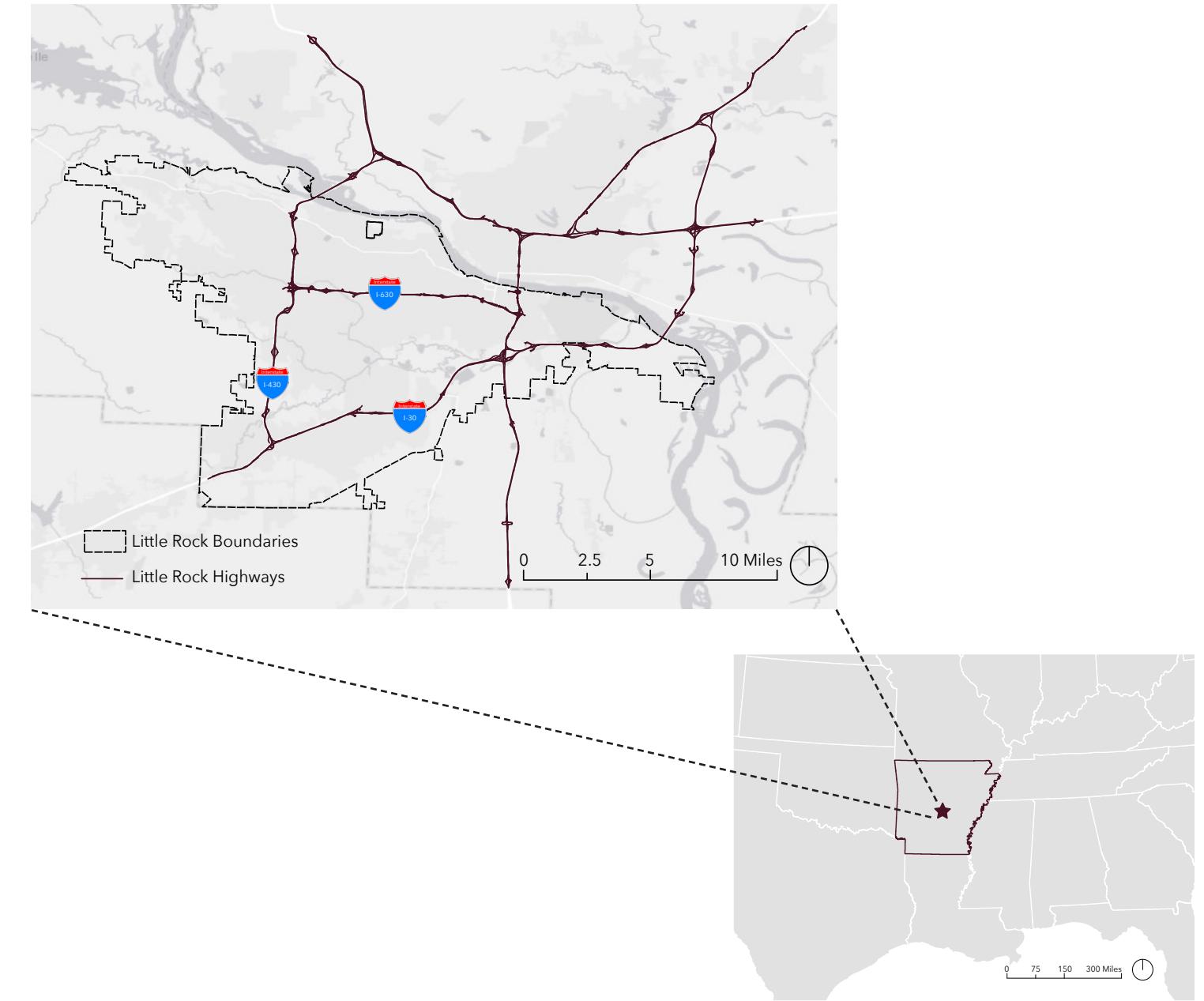
TABLE OF CONTENTS

1.0	Introduction	3
2.0	Research Question and Hypothesis	4
3.0	Methodology	5-8
4.0	Results	9-12
5.0	References	13



1.0 | INTRODUCTION

STUDY AREA



Interstate Highway I-630 has a checkered history. The highway, not originally part of the initial Interstate Highway System in 1955, was only built after city leaders pushed for it.

The highway took 25 years to build and was finally finished in 1985, due to delays from a lawsuit and lack of funding. Many families were displaced and a historically black business district were torn down in order to clear space for its right-of-way.

Today, there is debate amongst residents who believe that the Interstate contributed to suburbanization. In a city with a long history of segregation, suburbanization is viewed as deeply tied to white flight.

Although this history provided the initial inspiration to analyze Interstate 630, this project chose not to analyze historical factors that influenced the current road and highway layout of Little Rock.



2.0 | RESEARCH QUESTIONS AND HYPOTHESIS

RESEARCH QUESTIONS

- (1) Does I-630 in Little Rock cut automobile travel time from census block clusters with higher incomes for Little Rock to the three largest employment centers more or less than it cuts travel time from lower income clusters?
- (2) How much do the areas of the service areas from the employment centers decrease without Interstate highway I-630?

HYPOTHESIS

I-630 cuts automobile travel time from whiter and higher income clusters to the three largest employment centers more than it cuts travel time from lower income, less white neighborhoods.

3.0 | METHODOLOGY

OVERVIEW

This project performed a network analysis of the road and highway network in Little Rock, Arkansas, analyzing how automobile travel times across the network change if Interstate 630 did not exist.

Little Rock was divided based upon a clustering analysis of demographic and income attributes from 2017 ACS data for census block groups. Then, travel times between these areas were compared, with and without Interstate 630 using the current road network.

The project also compared the square mileage of the 20 minute drive service area with and without the highway to determine how much area was lost when the highway was removed.

LIMITATIONS

Limitations for the project are many and varied. A cluster analysis based only on income, demography ignores the complexity of human social interaction and the extent to which both commercial and residential centers act as sources of integration for various groups of people.

It is also limited by the accuracy of the data used. This project used single year ACS data from 2017. ACS data can be highly inaccurate in certain areas. This affected our clustering analysis due to likely inaccurate demographic information from the ACS - discussed further later in the report. This project chose to ignore issues with whether or not residents of the various parts of Little Rock would attribute meaning to the clusters our analysis produced.

Polyline shapefiles also do not include local speed limit variability, complicating the accuracy of the travel time predictions that the network analysis produces.

Furthermore, this project ignored topography costs on the network (i.e. driving more slowly while climbing a hill). Time while driving is also not experienced in a rational manner. For example, road traffic may exacerbate the perception of time moving slowly for certain people and cause the opposite for others.

PROCESS

OBTAINT DATASETS

CLEAN DATA CREATE DATA

PROJECT & DISPLAY

CLUSTER ANALYSIS

PART 1 NETWORK ANALYSIS:
BUILD NETWORK DATASETS

I-630 INCLUDED I-630 REMOVED

PART 2 NETWORK ANALYSIS:
TRAVEL TIME ANALYSIS

BUILD SERVICE AREAS OD COST MATRIX

ANALYZE RESULTS

DATASETS

Municipal Boundary
for Pulaski
County

US Street Network
Shapefiles, Nodes/Edges
From Open Street Map

Traffic Signals,
PAGis Arkansas

2010 US Census Bureau,
Census Tract Block
Groups: Little Rock, AR

2017 ACS Median
Household Income and
Demographic Data

Little Rock Regional
Chamber of Commerce
Employee Numbers

ASSUMPTIONS

The most important methodological assumption that this project made was in setting the time spent passing by traffic lights at 15 seconds. Unfortunately, there is not much documentation on this methodological issue. Thus, a best-educated guess was made by considering that one does not stop at every stoplight and that stop light times often vary based on road type.

METHODOLOGY

CLUSTER ANALYSIS

OBTAIN DATASETS

CLEAN
DATA

CREATE
DATA

PROJECT & DISPLAY

CLUSTER ANALYSIS

PART 1 NETWORK ANALYSIS:
BUILD NETWORK DATASETS

I-630
INCLUDED

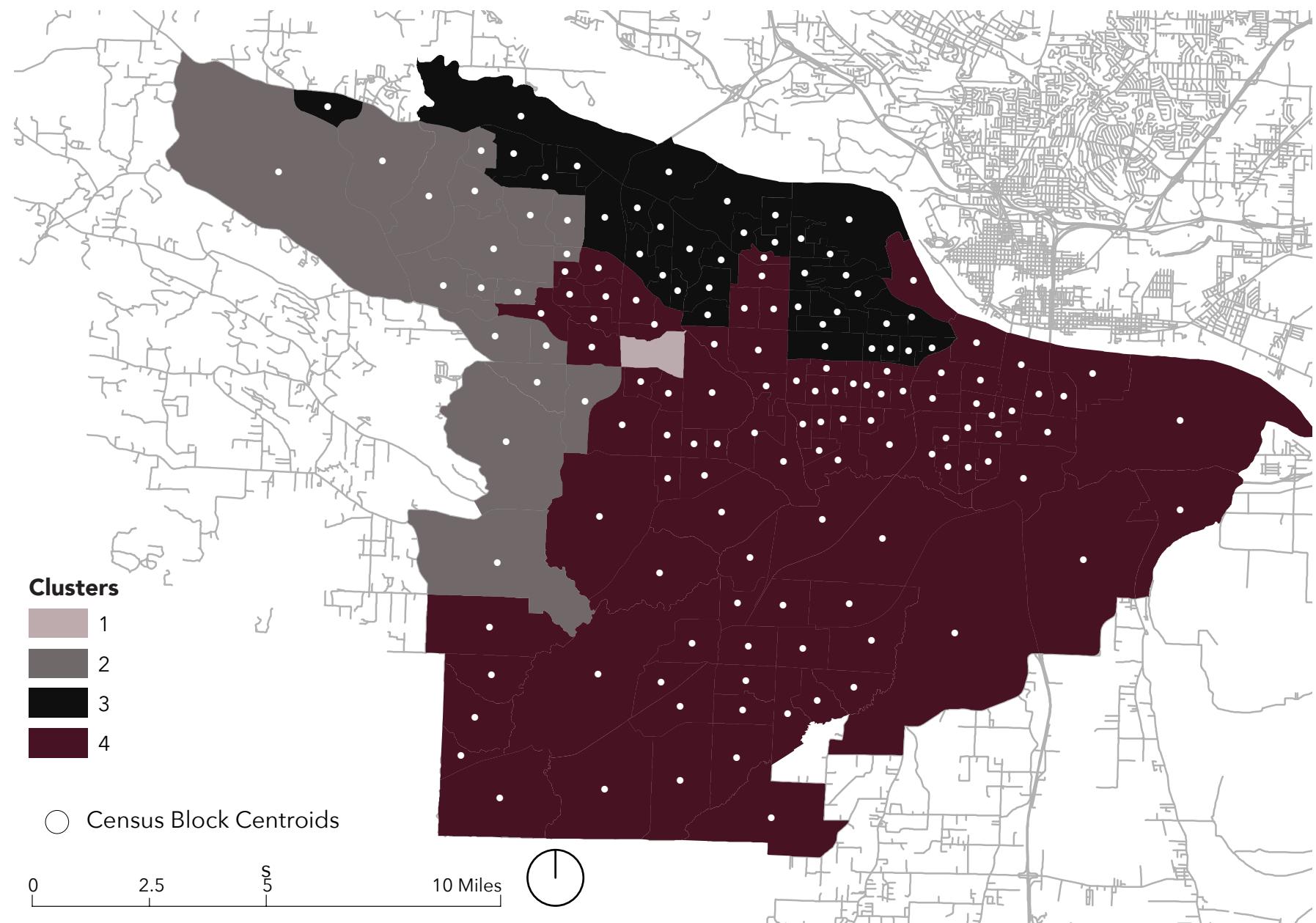
I-630
REMOVED

PART 2 NETWORK ANALYSIS:
TRAVEL TIME ANALYSIS

BUILD
SERVICE AREAS

OD COST
MATRIX

ANALYZE RESULTS

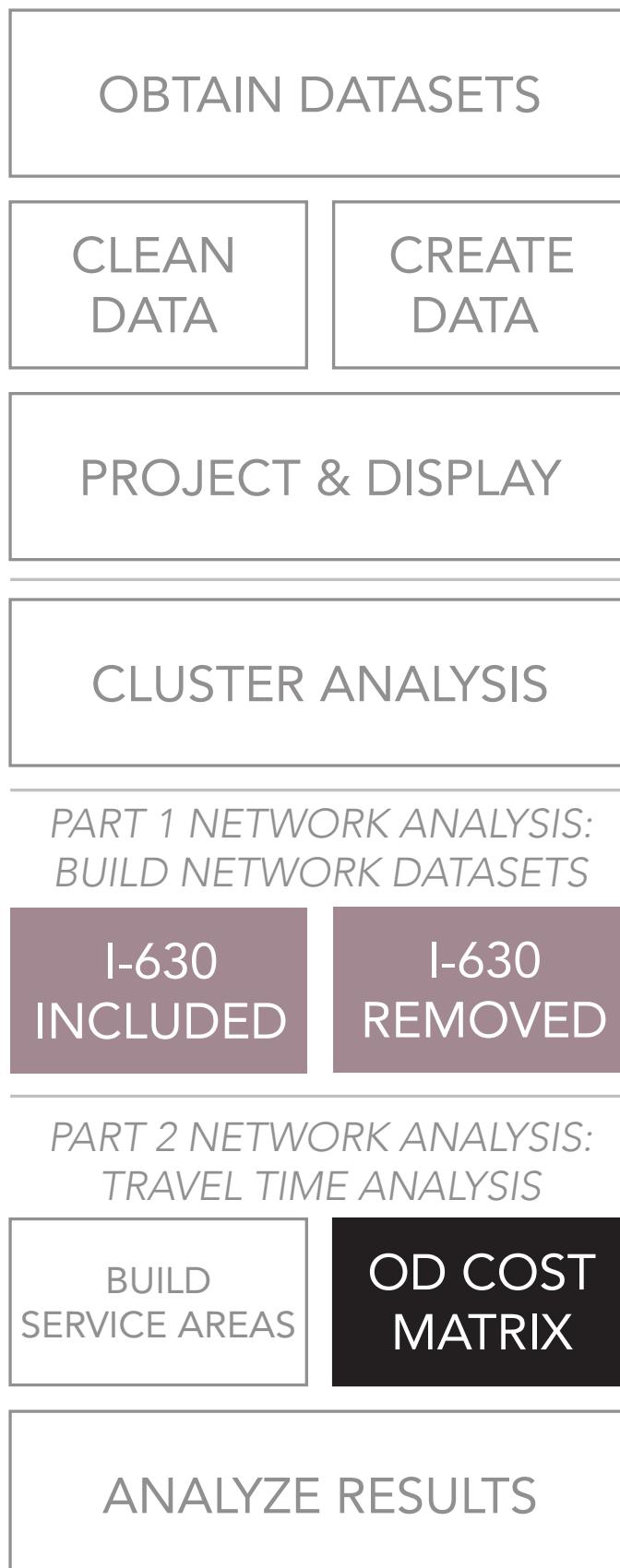


Using a clustering algorithm called “Grouping Analysis” developed by ESRI, census block groups were clustered based on median household income and demographic data, ignoring spatial relationships. The number of clusters was decided by choosing the clustering which produced the least variance among each cluster group. Spatially, this produced almost contiguous polygon shapes across Little Rock, with clusterings in the western, southern, northern, and central part of Little Rock.

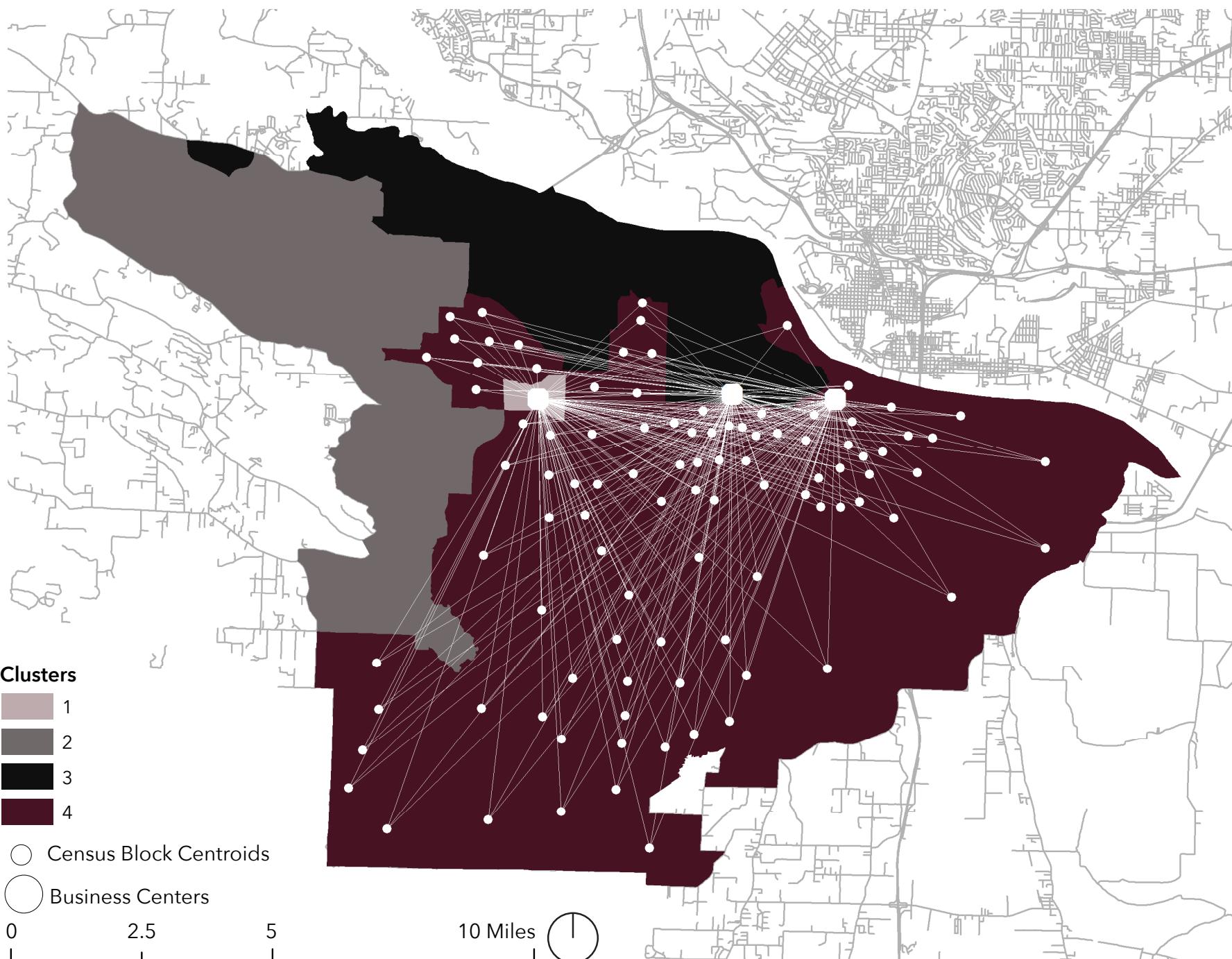
The grouping analysis produced cluster 1 most likely due to inaccuracy in the ACS data that was used, thus it was ignored in our OD Cost Matrix analysis. The inaccuracy can be observed when looking at the graphs of demographic information for each cluster. While it is possible that one census block group in Little Rock is around 20 percent Native American, this seems unlikely due to our examination of

METHODOLOGY

OD COST MATRIX ANALYSIS



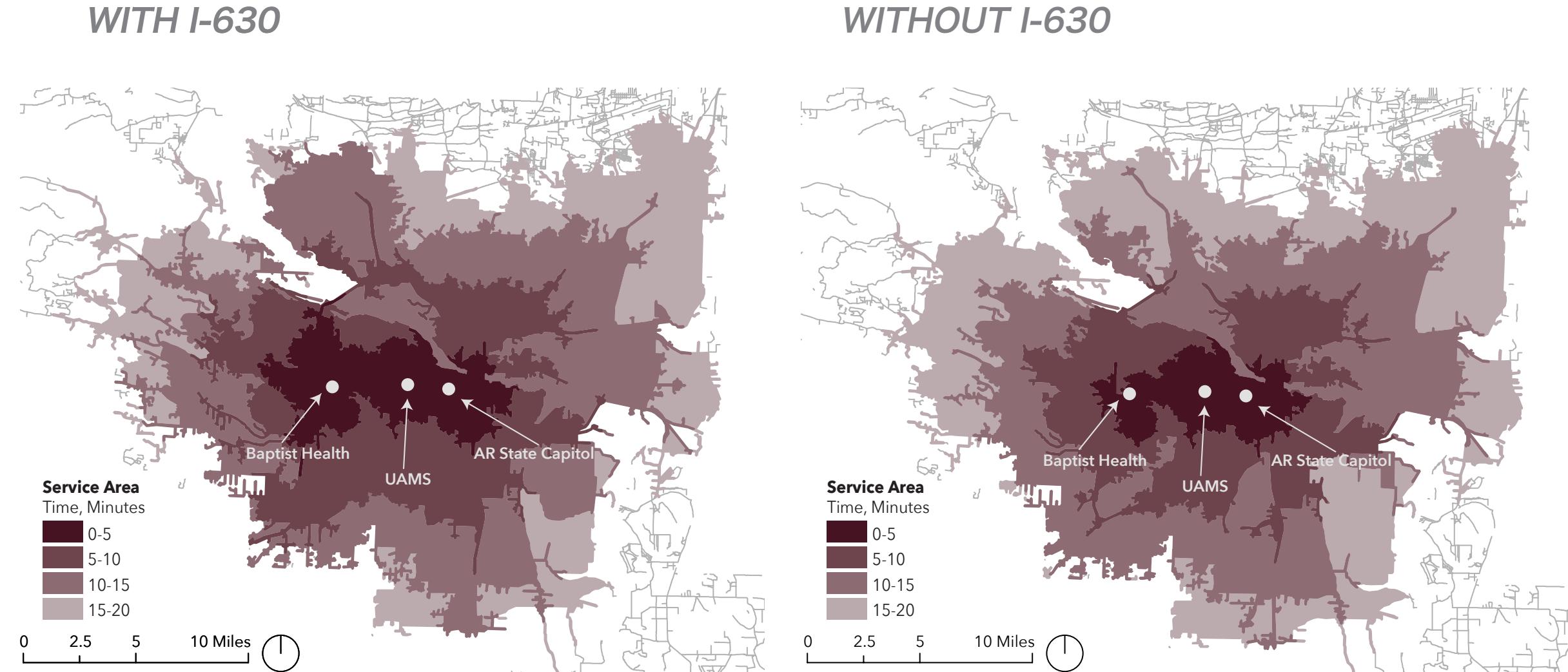
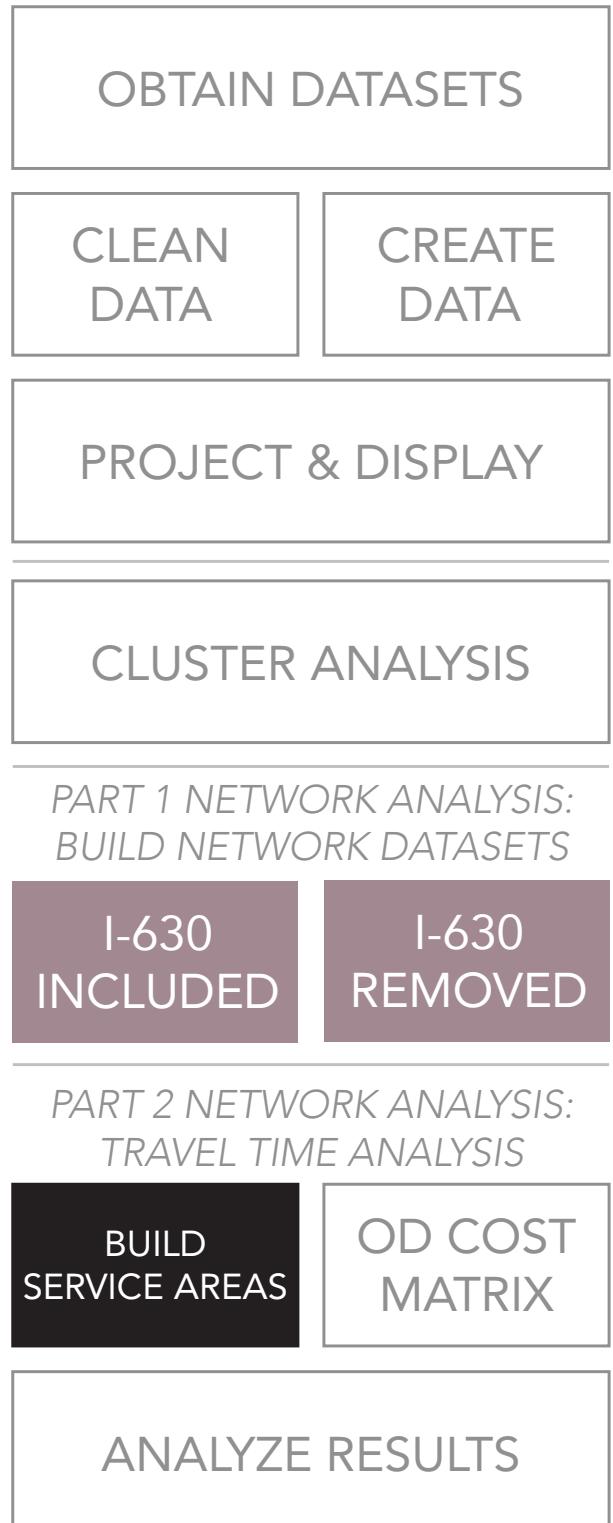
GROUP 4 OD COST MATRIX OUTPUT EXAMPLE



First, centroids were calculated for each census block group of each cluster produced from the clustering analysis. Then, the time it takes to travel to each employment center from each centroid was calculated, using an OD Cost Matrix analysis. This analysis calculates the least-cost path from each origin (the census block centroids) to each destination (the employment centers) along the network (the road network of Pulaski County). A map output example is included above. The straight lines do not represent the actual path taken, they only serve to illustrate the calculations performed by the analysis.

METHODOLOGY

SERVICE AREA ANALYSIS



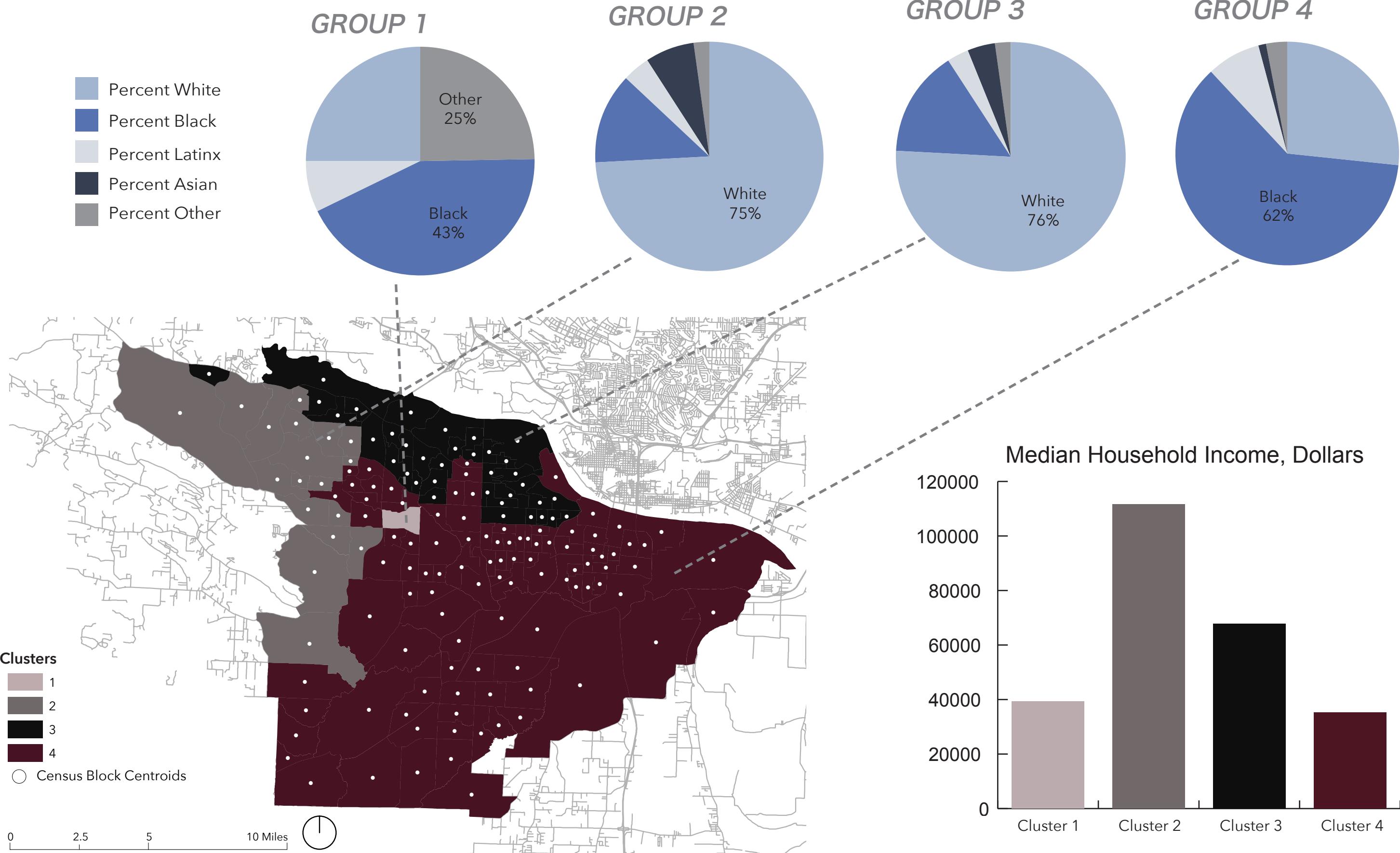
These service areas are a spatial representation of how long it takes to drive to outwards from “facilities” (the employment centers) along a network. Maps of the service areas with and without Interstate 630 are shown above. The services areas represent driving times of 5, 10, 15, and 20 minutes.

4.0 | RESULTS



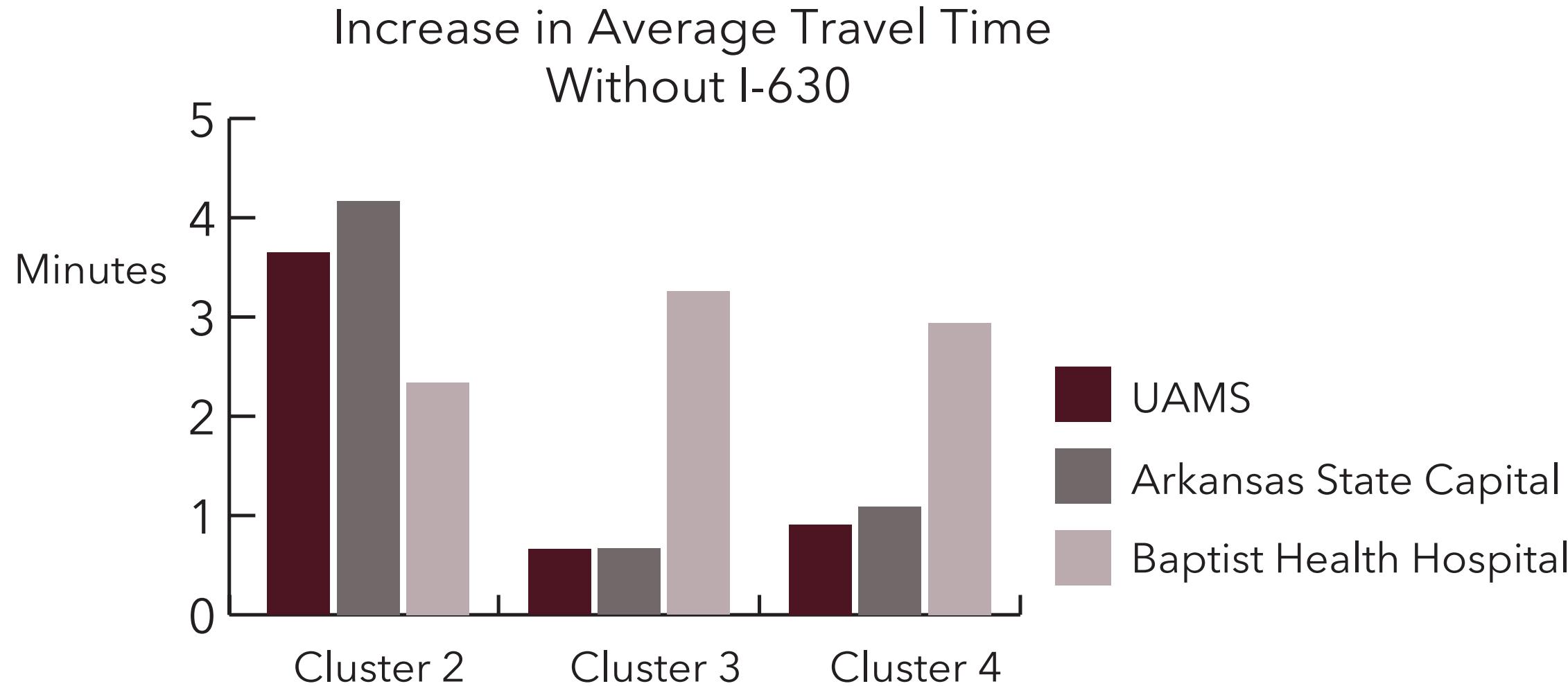
RESULTS

CLUSTER ANALYSIS



RESULTS

OD COST MATRIX ANALYSIS

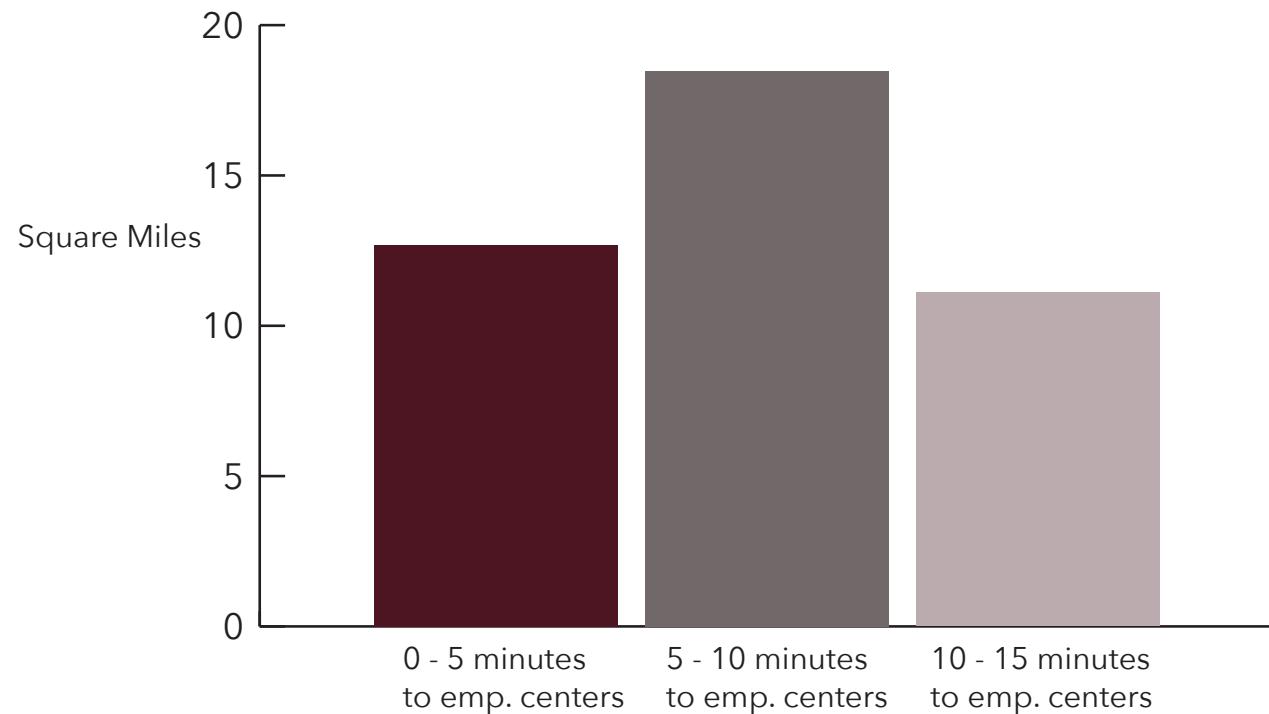


As shown in the results of the clustering analysis, there are significant differences in demographics and income between areas of Little Rock. Given these differences, it is telling that, without I-630, the largest impact on average travel time to the three largest employment centers is in the wealthiest clustering of census block groups i.e. Group 2. Baptist Health Center, which is located directly off of I-630, is the most impacted in terms of the speed with which one can drive to it.

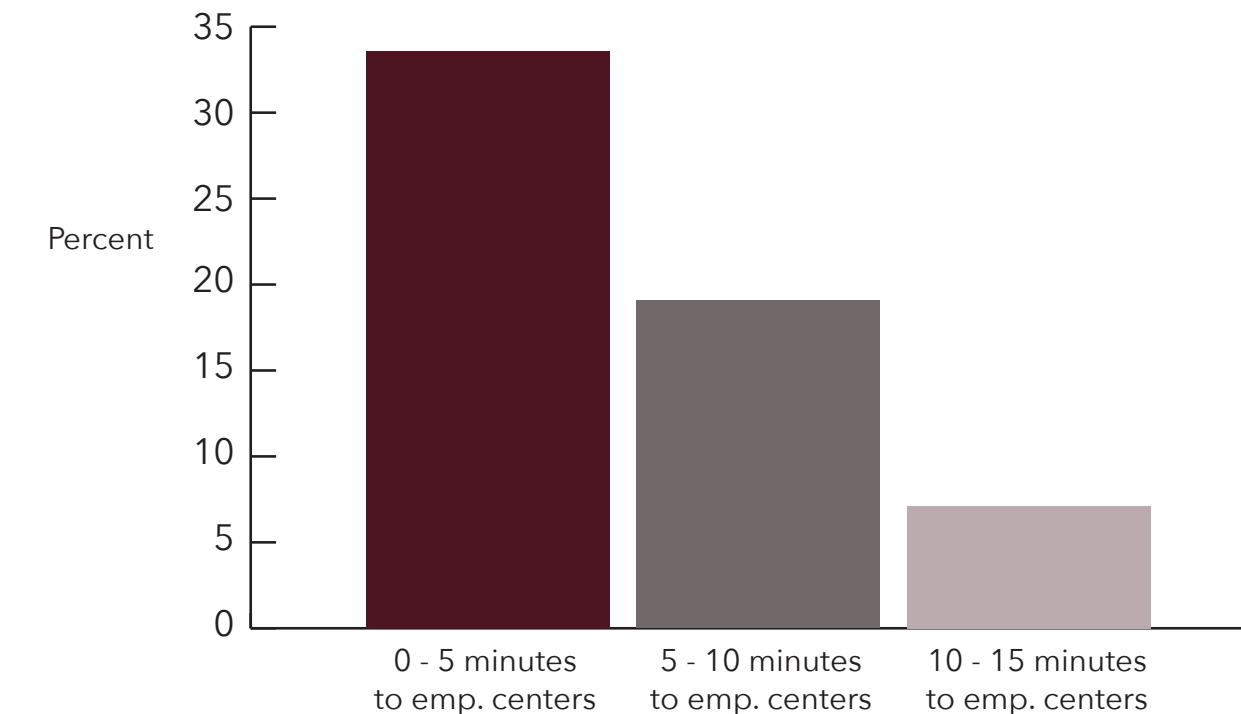
RESULTS

SERVICE AREA ANALYSIS

Square Miles Lost for Each Service Area without I-630



Percent Difference in Square Miles for Each Service Area without I-630



Based on the results of the OD Cost Matrix analysis, the removal of Interstate 630 would most impact the wealthiest clustering of census block groups. Seeking to provide a counterpoint to this project's equity-based approach in analyzing the removal of I-630, the square mileage coverage of service areas was also computed. The results of this service area analysis are shown in the above two graphs. It is clear that the speed with which one can traverse Pulaski County to the main employment centers would be greatly affected by the removal of the highway. This project was meant to imagine what the impacts of removing a highway with a checkered history would be in Little Rock, Arkansas. It raises more questions than provides answers to this imagining.

4.0 | REFERENCES

Arkansas GIS Office. (2019). Municipal Boundaries (Polygon) | Arkansas GIS Office. Retrieved December 10, 2019, from <http://gis.arkansas.gov/product/municipal-boundaries-polygon/>

Boeing, G. (2018). U.S. Street Network Shapefiles, Node/Edge Lists, and GraphML Files [Data set]. <https://doi.org/10.7910/DVN/CUWWYJ>
ESRI. (2011). State Capital shapefiles. Retrieved December 11, 2019, from <https://www.arcgis.com/home/item.html?id=3b3fbb0a71d0413e-b707ad7dc5b269a9>

Holley, J. (2017). Traffic Signals in Pulaski County. Pulaski County, Arkansas: PAGIS.

Koon, D. (2011, January 26). Wilbur Mills' wall. Retrieved December 10, 2019, from Arkansas Times website: <https://arktimes.com/news/cover-stories/2011/01/26/wilbur-mills-wall>

Little Rock Regional Chamber of Commerce. (2019). Major Employers. Retrieved December 10, 2019, from Little Rock Regional Chamber website: <https://www.littlerockchamber.com/economic-development/locate-or-expand/major-employers/>

U. S. Census Bureau. (2017). American FactFinder. Retrieved December 10, 2019, from <https://factfinder.census.gov/faces/nav/jsf/pages/index.xhtml>

U.S. Census Bureau. (2017). TIGER/Line Shapefiles for States, 2017, nation, U.S., Current State and Equivalent National—Data.gov. Retrieved December 11, 2019, from <https://catalog.data.gov/dataset/tiger-line-shapefile-2017-nation-u-s-current-state-and-equivalent-national>

U.S. Census Bureau. (2017). Geography Program. Retrieved December 10, 2019, from The United States Census Bureau website: <https://www.census.gov/programs-surveys/geography.html>