

# Urban Segregation and Pollution in Charlotte, NC

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A dark blue, diagonal graphic element that starts from the bottom left corner and extends towards the top right, creating a sense of movement and depth. It occupies the lower half of the slide.

# Background

Though the Civil Rights Act of 1964 marked the end of segregation in the United States, the legacy of its policies and practices lingers in the present day through residential segregation.

The employment of urban segregation causes disproportionate accessibility to resources and exposure to potential pollutants and health risks.

The evolving state of the earth has turned the spotlight towards environmental risks deriving from structural discrimination.

# Research Question & Hypothesis

How does race, class, and other socioeconomic indicators affect the rates of exposure to various forms of air pollution?

Hypothesis: Areas considered more socially vulnerable will be exposed to higher levels of air pollution.

# Data Sources

US Census ACS 5-Year Estimates  
for Demographic Data

Mecklenburg Open Mapping and  
OpenStreetData for Local Location  
Data

NASA Socioeconomic Data and  
Applications Center (SEDAC) for  
Environmental Data

# Variables

Demographic	Geographic	Environmental
Minority status	Landfills	NO2 Concentration
Below 150% poverty level	Waste Facilities	O3 Concentration
Population 25+ with no high school diploma	Industrial Plants	PM2.5 Concentration
Population 16+ that are unemployed		
Civilian noninstitutionalized with no health insurance		
Over 65 years old		
Under 17 years old		
Civilian noninstitutionalized with a disability		
Speak English less than "very well"		
Workers 16+ no vehicle available		
Renter-occupied housing		
No internet access		
With cash public assistance or food stamps/SNAP		

# Methodology

Extracted specified variables from the US Census using tidycensus library on the census tract level

Represented each variable as a percentage of the total population or total housing units

Retrieved point and polygon location data for geographic variables

Calculated the minimum distances from each tract

Scaled data before using K-Means to form seven geodemographic clusters

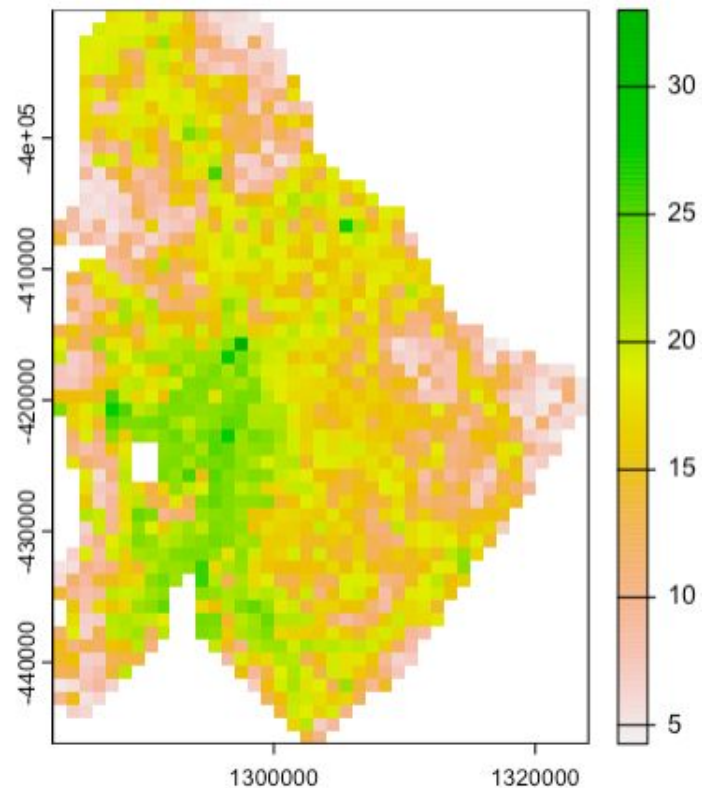
Calculated global mean difference for each cluster center and created radial plots and a heat map to explore cluster identity

Derived raster maps for pollution measurements and used terra::extract to match average with tracts

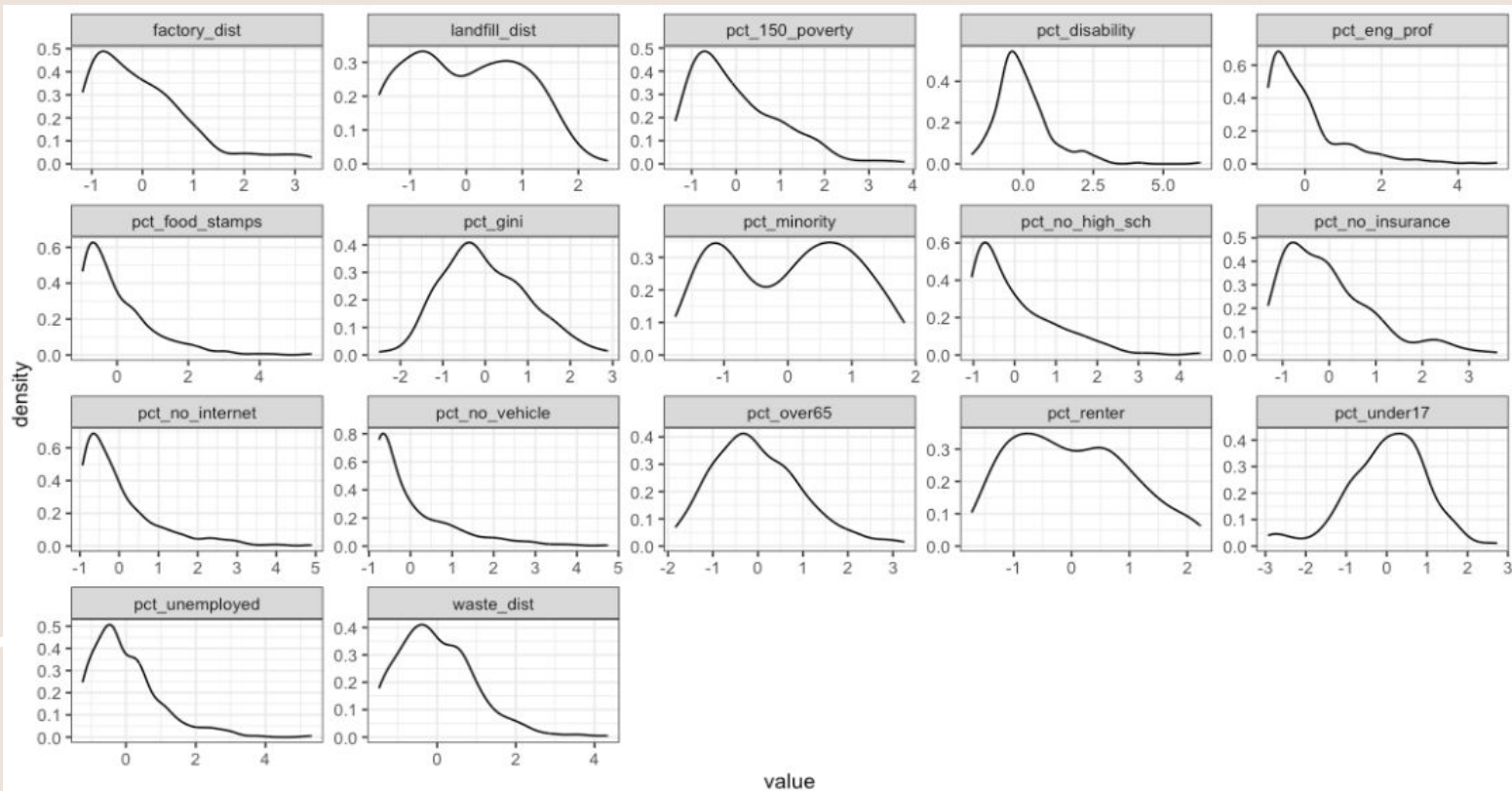
Constructed density maps of pollution by cluster

# Raster Map

Annual NO<sub>2</sub> Concentration in a  
1-km grid (2016)



# Variable Density Plots





# Cluster Map

Seven Clusters:

One - 46 tracts

Two - 56 tracts

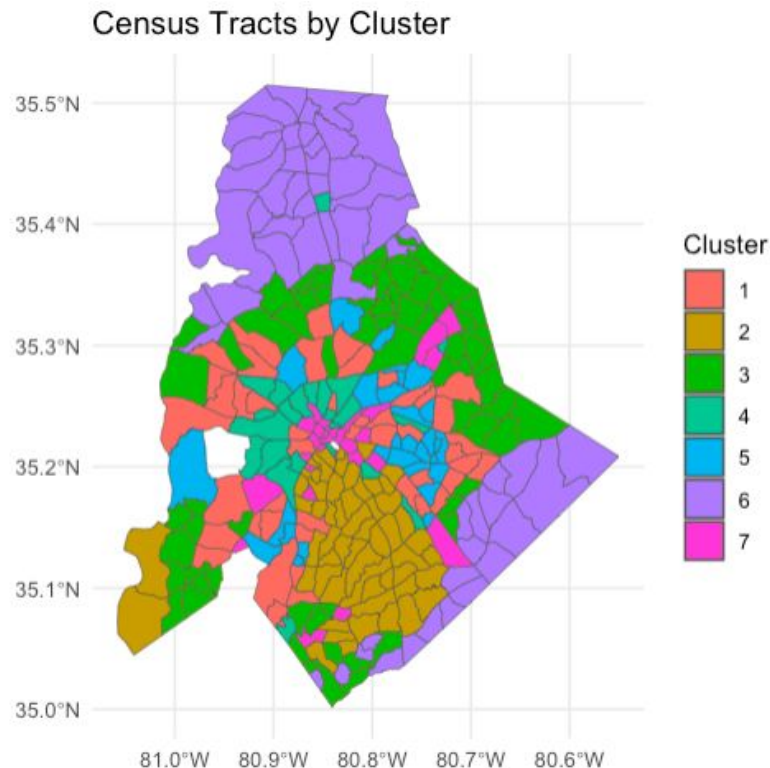
Three - 66 tracts

Four - 23 tracts

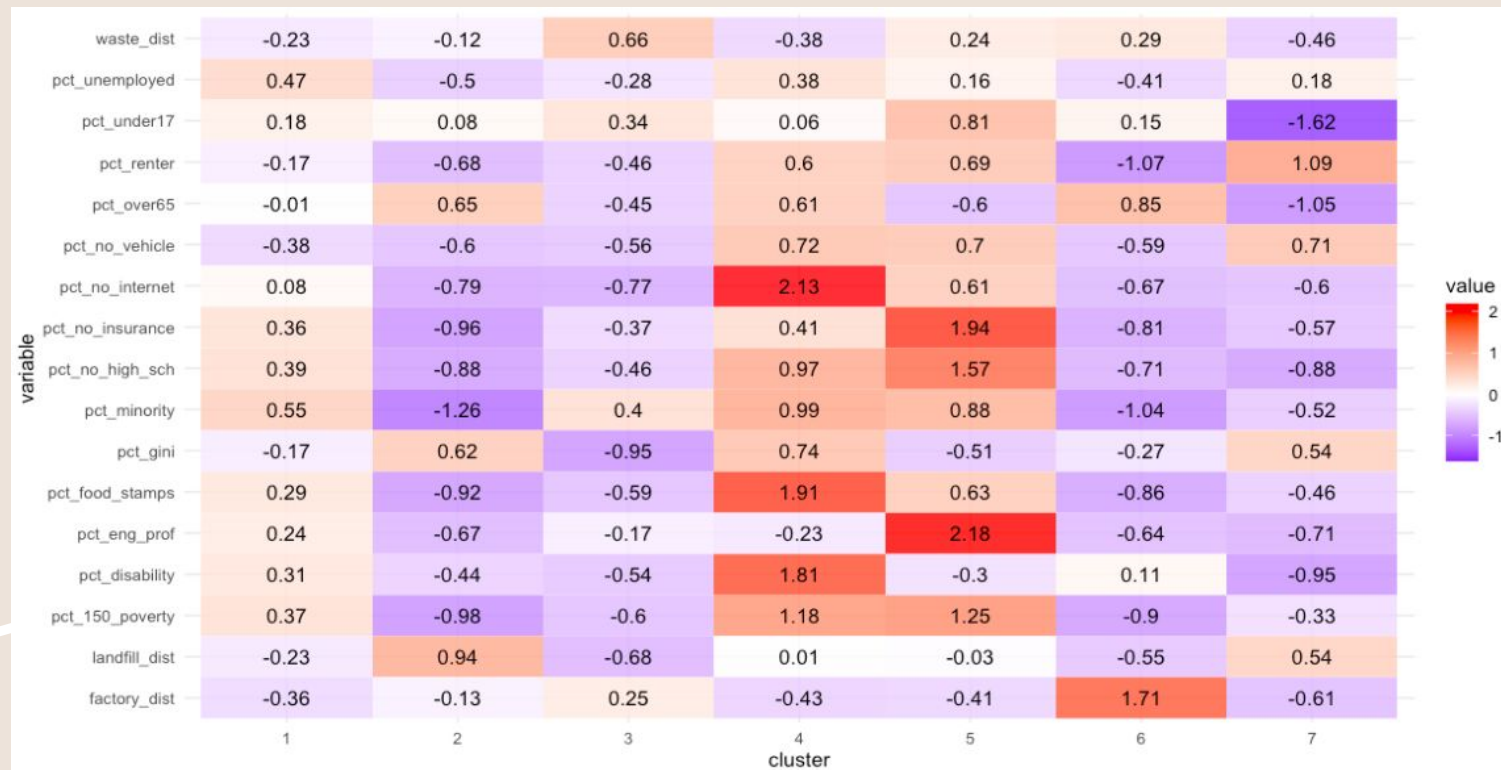
Five - 28 tracts

Six - 54 tracts

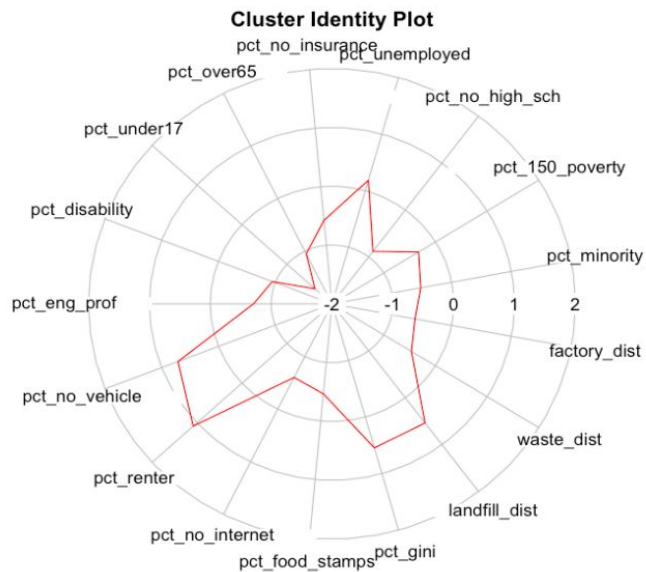
Seven - 29 tracts



# Cluster Heat Map



# Cluster Identity



One - Above average unemployment, minority status, but higher vehicle ownership

Two - Very low social vulnerability, higher income inequality, higher retired population

Three - Low income inequality, closer to landfills, farthest from waste facilities

Four - High social vulnerability, less internet access, more food stamps, more disability statuses

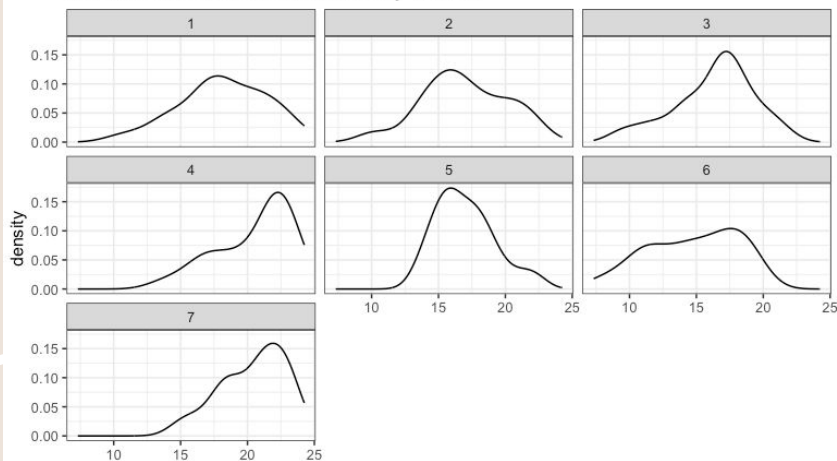
Five - High social vulnerability, less English proficiency, less high school graduates, no insurance

Six - High retired population, less renters and minorities, low poverty

Seven - Most renters with no vehicle, very low child and retired population, low disability statuses

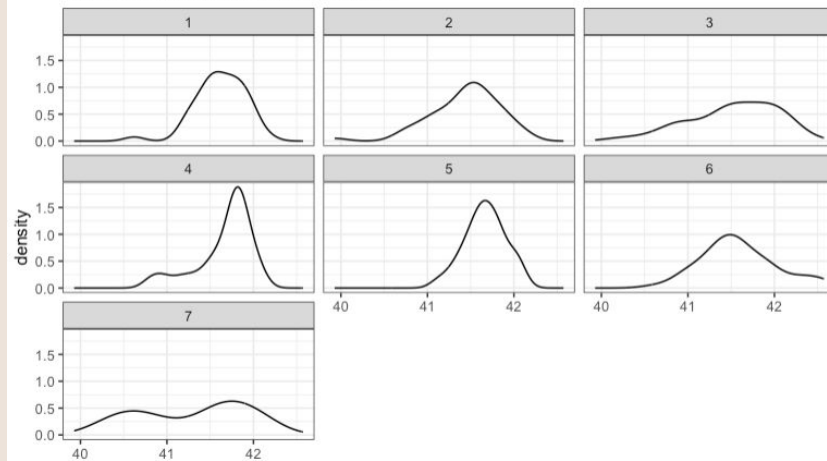
# Pollution Distribution Plots

Annual Mean NO2 Concentration by Cluster



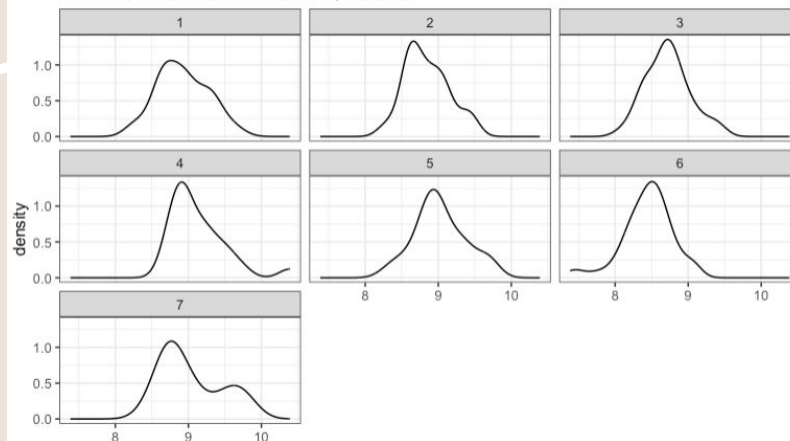
Average NO2

Annual O3 Concentration by Cluster



Average O3

Annual PM2.5 Concentration by Cluster



Average PM2.5

# Conclusions

Four (most socially vulnerable) shows more frequently occurring values on the higher end of the NO<sub>2</sub> and O<sub>3</sub> spectrum and seven shows on the NO<sub>2</sub> spectrum.

PM<sub>2.5</sub> is consistent throughout all clusters.

There is not enough evidence to state that socioeconomic status is highly correlated with pollution exposure.

Though the overall pollution measures are within industry standards, as the climate continues to change, those most vulnerable will face the burden first.

Further steps could be exploring more sources of pollution, collecting health data to assess risk, and using more clusters.