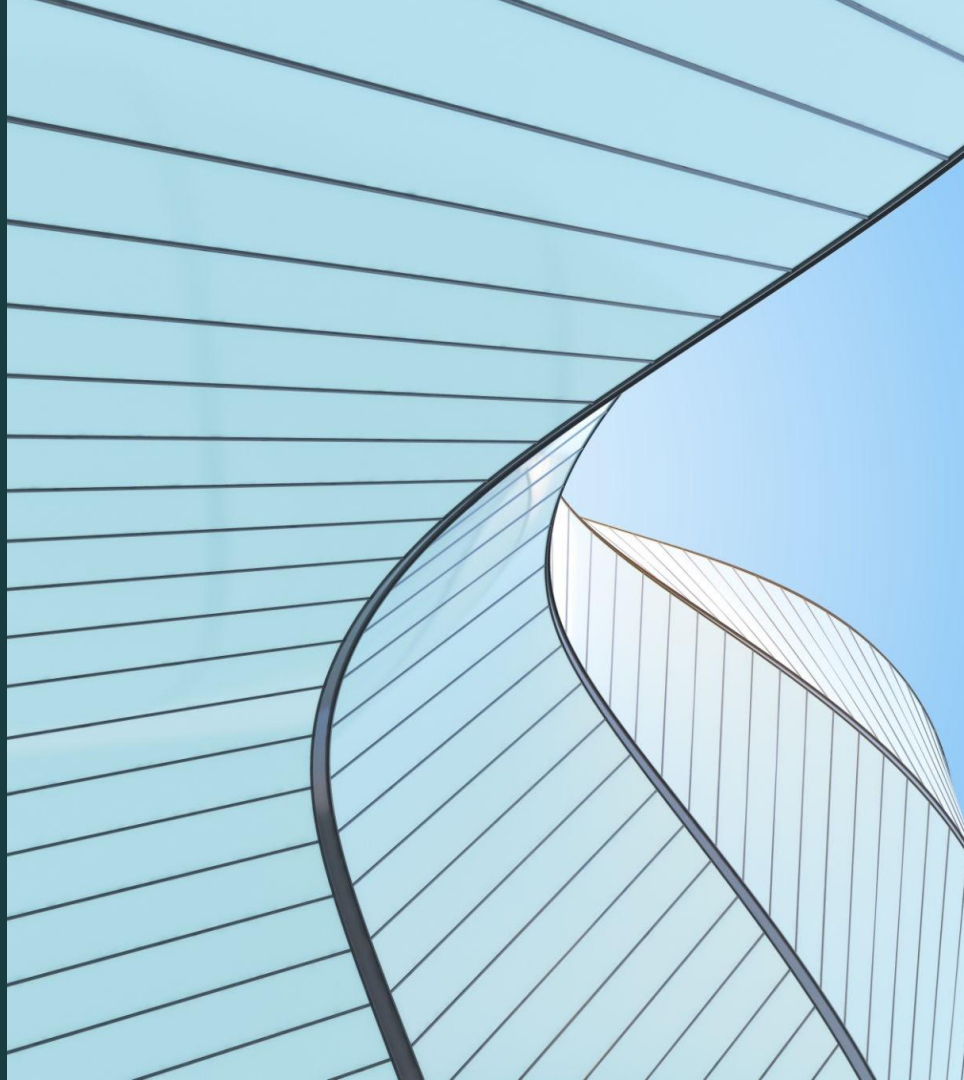
Mary Behnke and Allen Lopez
Oct 6

# Improving Air Quality

Tackling poor air quality and providing avenues for improvement in order to prevent adverse health outcomes



# Content *overview*

Importance of Air Quality

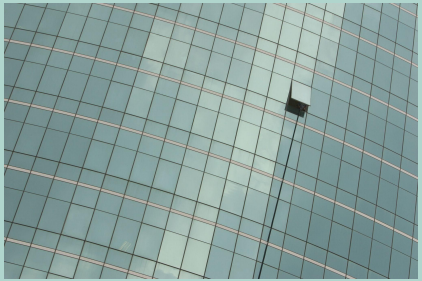
Communities Adversely Affected

Air Quality Factors

Solutions

**Air quality** is something that affects **everyone, everywhere, all the time.** Few individuals are in the proper positions to take action to improve air quality for any given area. Thus, it is important to **identify** some of the **most important air quality factors** to help inform policy makers on how to better serve their constituents.

# Some Effects of Bad Air Quality:



## Short Term Effects

- **Respiratory problems** (acute for those with existing conditions)
- Eye irritation
- Nausea

## Long Term Effects

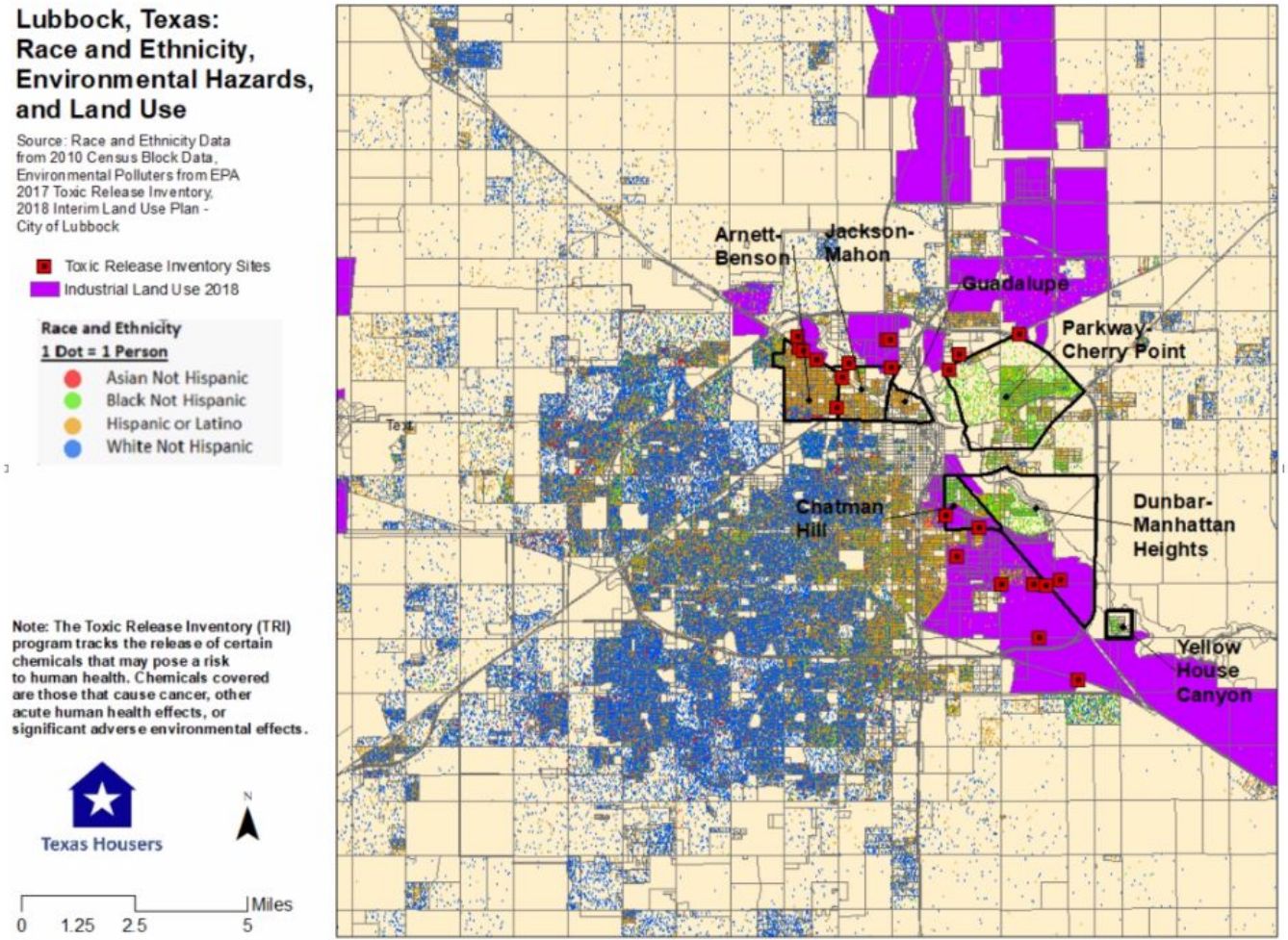
- Respiratory diseases: Chronic Bronchitis, Emphysema, COPD
- Development of **Asthma in Children**
- Cardiovascular diseases: Artery calcification, Stroke, **Heart Disease**
- Neurological problems: Cognitive decline, **Dementia**, Parkinsons

“When the city formulated its first comprehensive plan in 30 years — "Plan Lubbock 2040" — in 2018, several East Lubbock residents brought the **air quality issue** to the forefront of the conversation throughout the planning process.”

Lubbock Avalanche Journal, 2023

# Lubbock, Texas: Race and Ethnicity, Environmental Hazards, and Land Use

Source: Race and Ethnicity Data from 2010 Census Block Data, Environmental Polluters from EPA 2017 Toxic Release Inventory, 2018 Interim Land Use Plan - City of Lubbock




Note: The Toxic Release Inventory (TRI) program tracks the release of certain chemicals that may pose a risk to human health. Chemicals covered are those that cause cancer, other acute human health effects, or significant adverse environmental effects.

THE SOLUTION

# Build a model that predicts the health outcome based on the air quality, identifying most impactful characteristics

**01**

VARIABLES TO LOOK AT

Exploratory Data Analysis highlights possible impactful variables

**02**

RANDOM FOREST

Random Forest gives predictions and variable importance

**03**

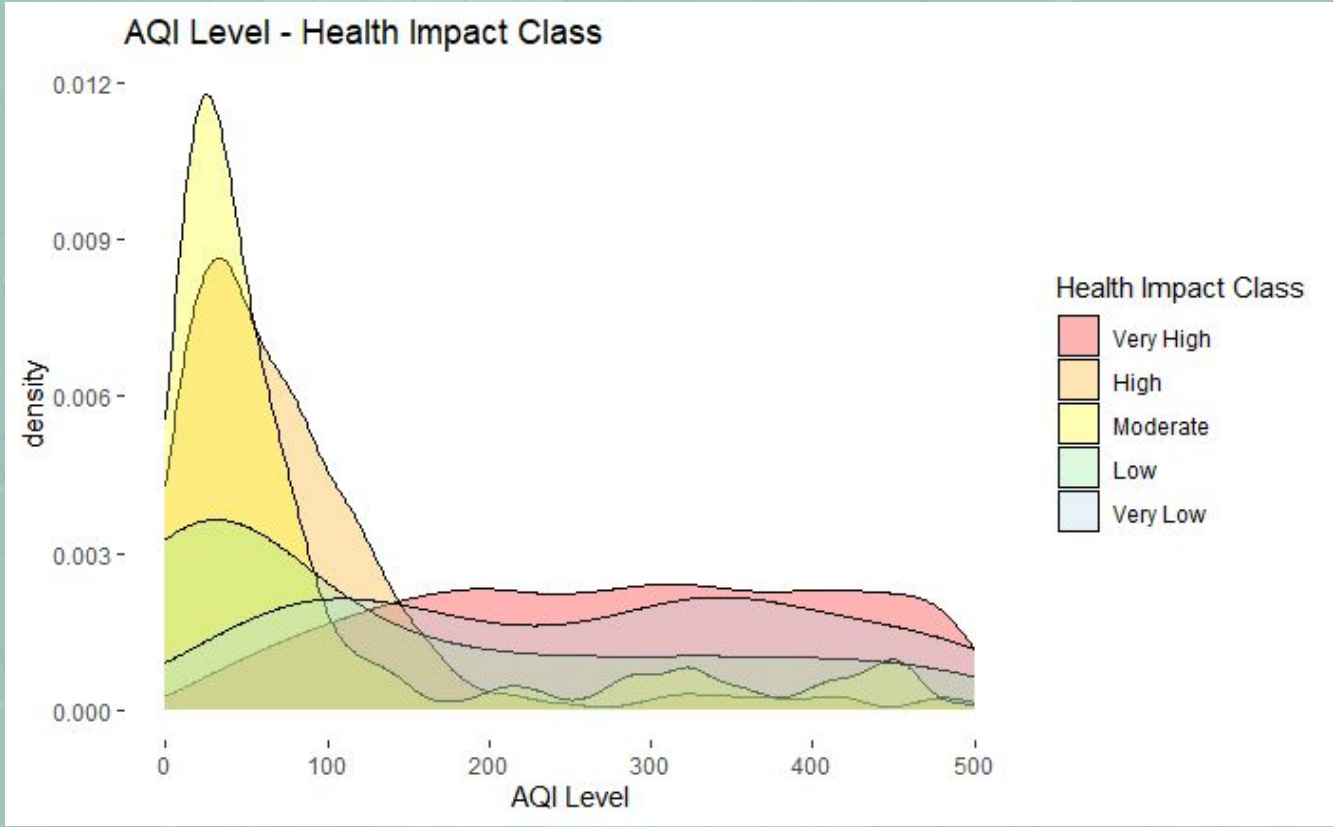
XGBOOST

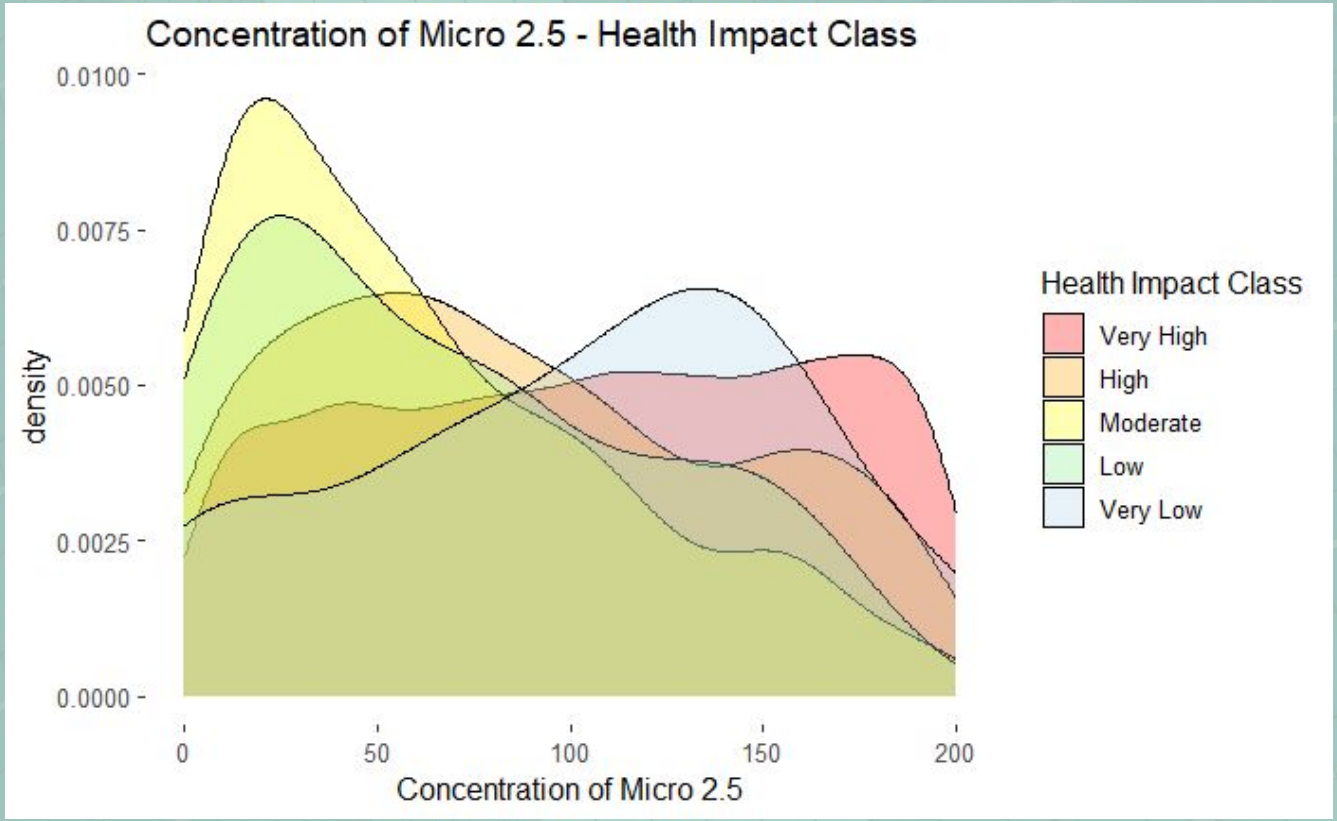
XGBoost gives predictions and variable importance

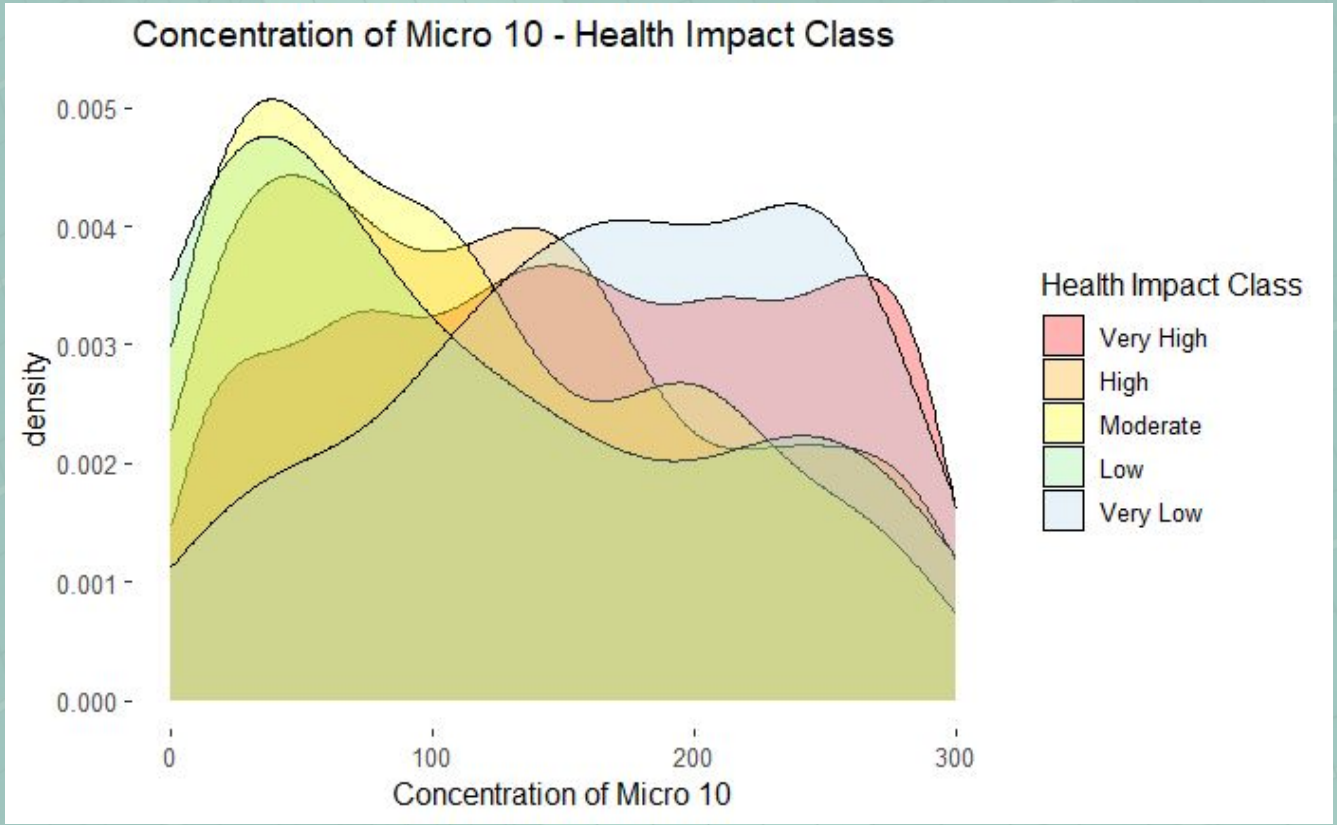
**04**

RECOMMENDATIONS

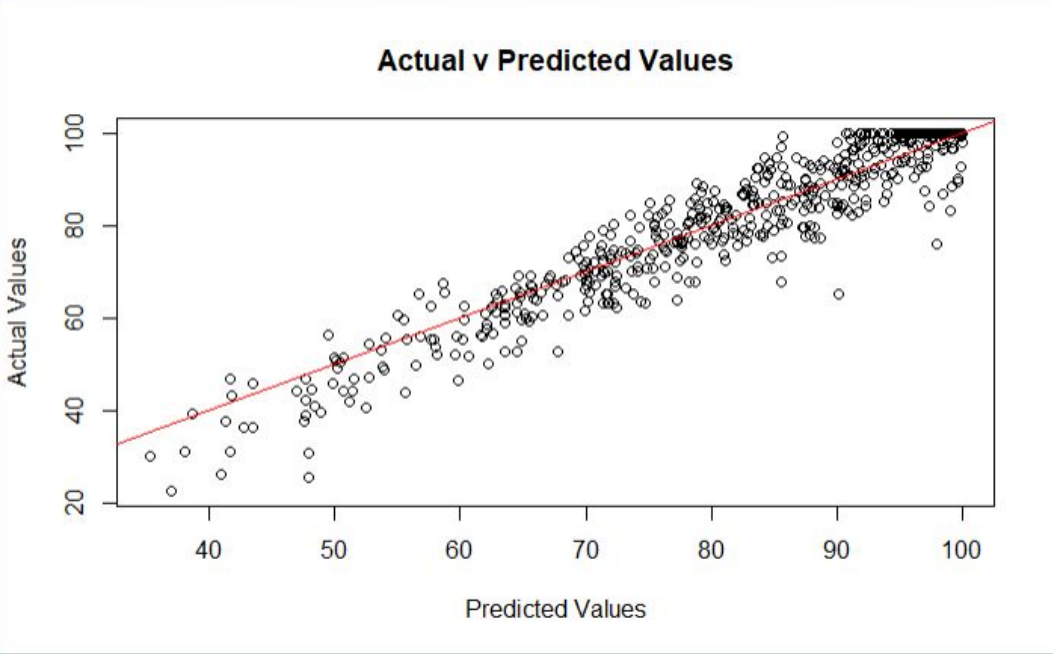
Synthesizing findings and finalizing solution


AQI Level - Health Impact Class
density
0.012
0.009
0.006
0.003
0.000
0
100
200
300
400
500
AQI Level
Health Impact Class
Very High
High
Moderate
Low
Very Low


Concentration of Micro 2.5 - Health Impact Class
0.0100
0.0075
0.0050
0.0025
0.0000
density
0
50
100
150
200
Concentration of Micro 2.5
Health Impact Class
Very High
High
Moderate
Low
Very Low

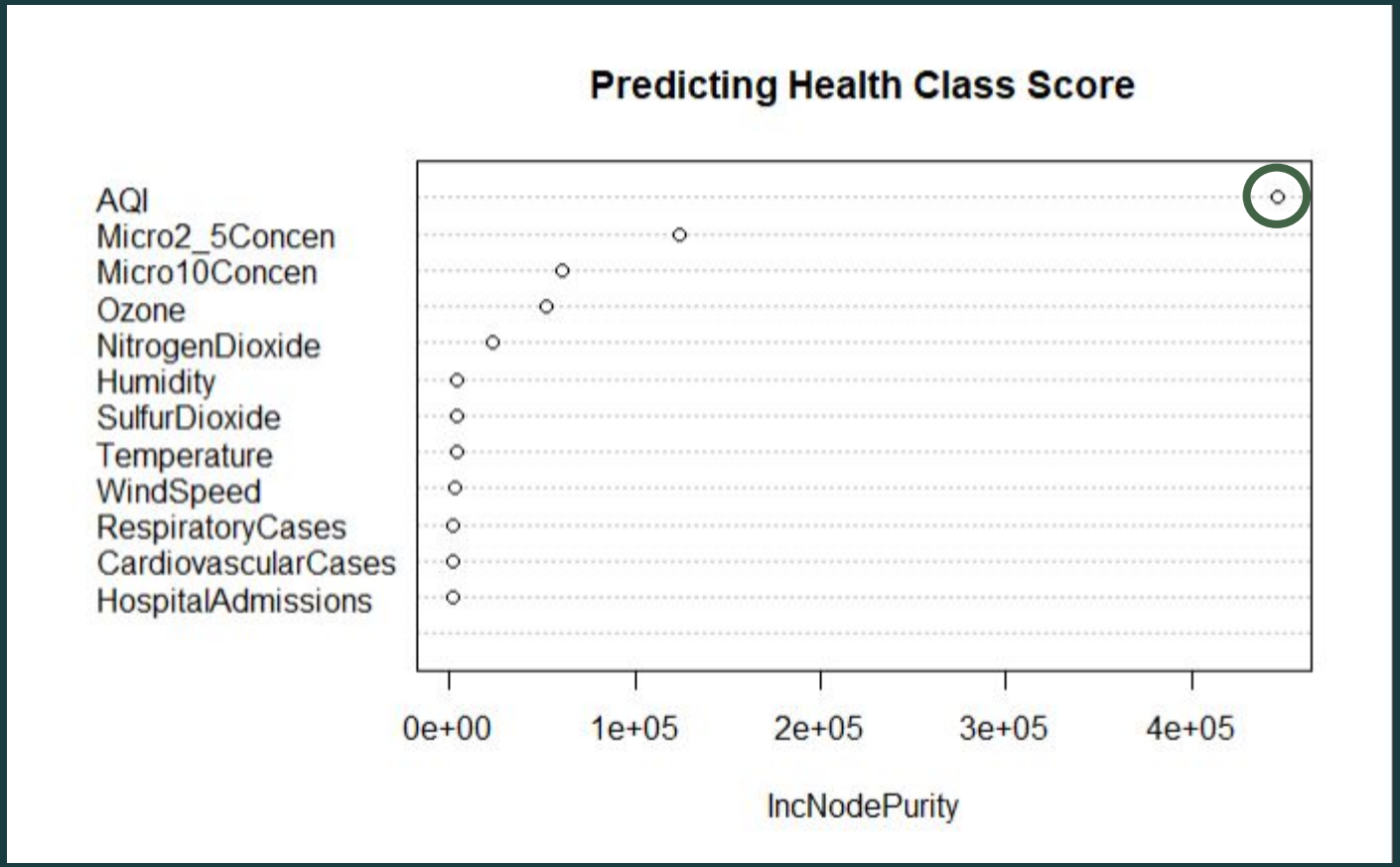

Concentration of Micro 10 - Health Impact Class
density
0.005
0.004
0.003
0.002
0.001
0.000
0
100
200
300
Concentration of Micro 10
Health Impact Class
Very High
High
Moderate
Low
Very Low

# The Random Forest Model performed well in predicting Health Impact Score

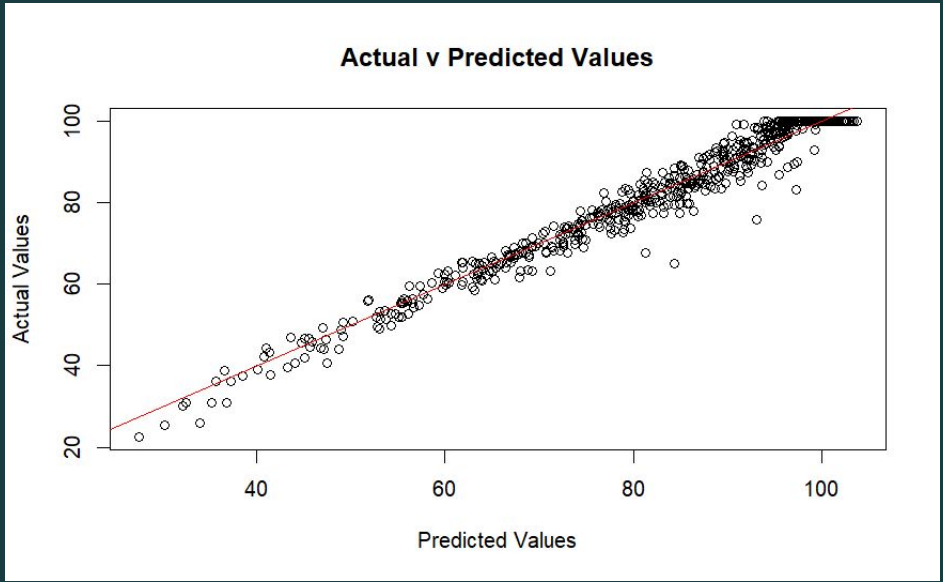


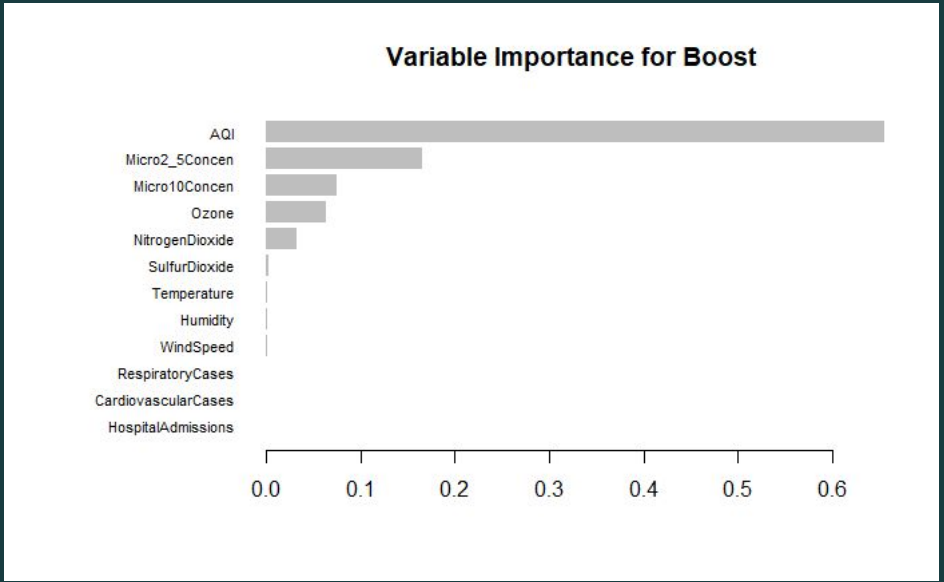

Variable Importance Ranking:

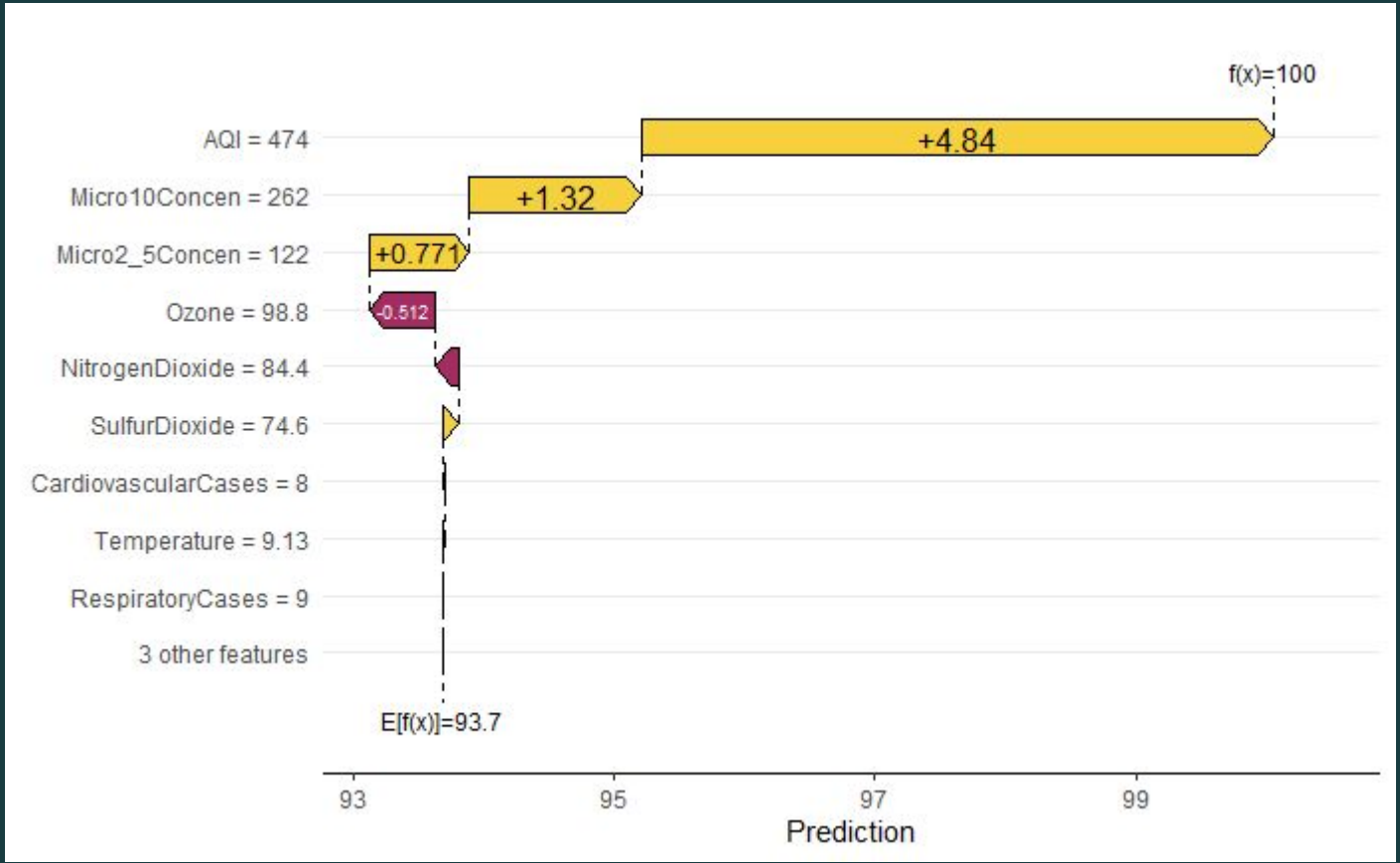
- AQI
- 2.5 particulate concentration
- 10 particulate concentration
- Ozone
- Nitrogen Dioxide
- Sulfur Dioxide
- Humidity


Predicting Health Class Score
AQI
Micro2_5Concen
Micro10Concen
Ozone
NitrogenDioxide
Humidity
SulfurDioxide
Temperature
WindSpeed
RespiratoryCases
CardiovascularCases
HospitalAdmissions
0e+00
1e+05
2e+05
3e+05
4e+05
IncNodePurity

# The XGBoost Model also performed well in predicting Health Impact Score



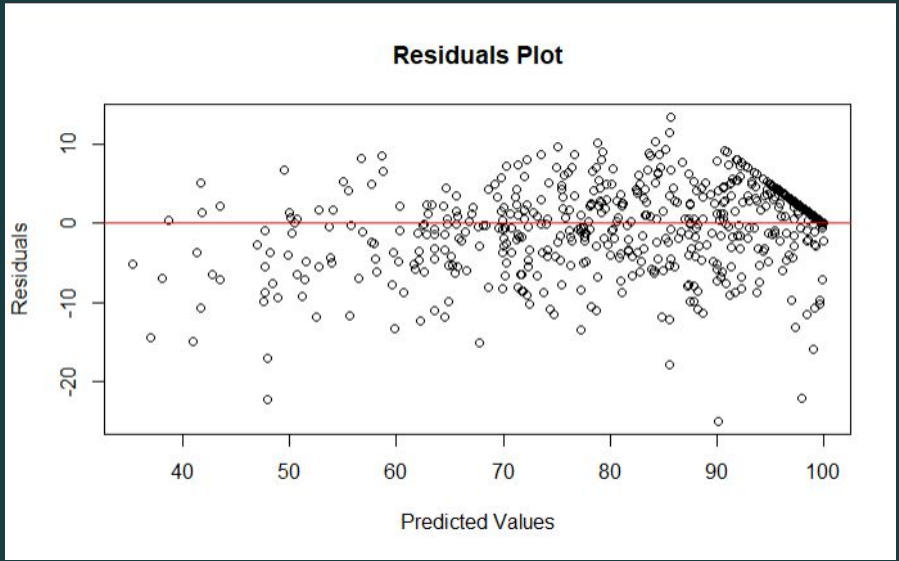

f(x)=100
AQI = 474
+4.84
Micro10Concen = 262
+1.32
Micro2_5Concen = 122
+0.771
Ozone = 98.8
-0.512
NitrogenDioxide = 84.4
SulfurDioxide = 74.6
CardiovascularCases = 8
Temperature = 9.13
RespiratoryCases = 9
3 other features
E[f(x)]=93.7
93
95
97
99
Prediction

# Model comparison

RANDOM FOREST MODEL

Mean Square Error: 9.368

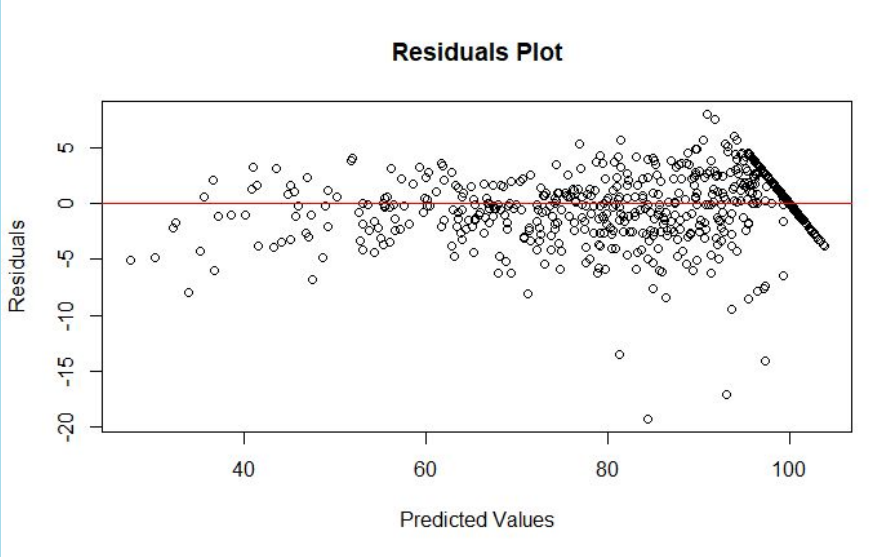
Residuals:




XGBOOST MODEL

Mean Square Error: 1.825984

Residuals:



# Most Impactful Factors

## Air Quality Index

AQI would naturally be very important here, and the next most important factors are those that are used to calculate AQI. Therefore, AQI can be used in more broad situations to look at health impact, but other factors can can be targets of improvement

## Particulate Matter Concentration

The concentration of particulate matter less than 2.5 or 10 micrometers in diameter are the second most impactful factors, making them important targets for improving air quality and predicting health impact

## Other Factors

Ozone and Nitrogen Dioxide are also notably impactful, and can therefore be focused on when aiming to improve air quality

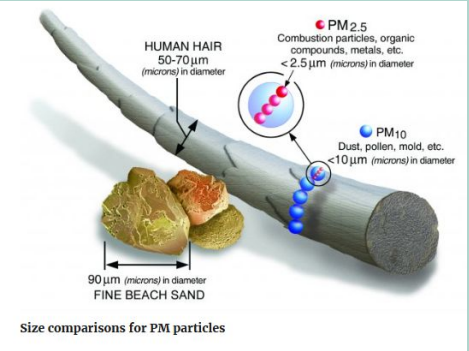
## Policymakers

The EPA already sets standards for six criteria pollutants: carbon monoxide, lead, nitrogen dioxide, ozone, particle pollution, and sulfur dioxide

Given our findings, policymakers should make an effort to reduce **particle pollution** the most, followed by **ozone**, then **nitrogen dioxide**.

Furthermore, The EPA notes that particle pollution can originate from a variety of sources, including construction sites, fires, power plants, and industry.

Policymakers could strengthen regulations on the **minimum distance** from nearest residential or public use area that industry/power plants could be, as well as prioritizing efficient construction and fire prevention.



Size comparisons for PM particles

## Researchers

Continue delving into methods of filtration and pollutant removal

## Average Person

Monitor AQI before going outside

- Wear a mask when levels are elevated
- Invest into home air filters and purifiers

# Thank you

Any questions?

Used quote from this article:
Lubbock Avalanche Journal

Used image from this article:
Lubbock Jim Crow history

EPA on particulate matter:
EPA Particulate Matter
Table on Pollutants