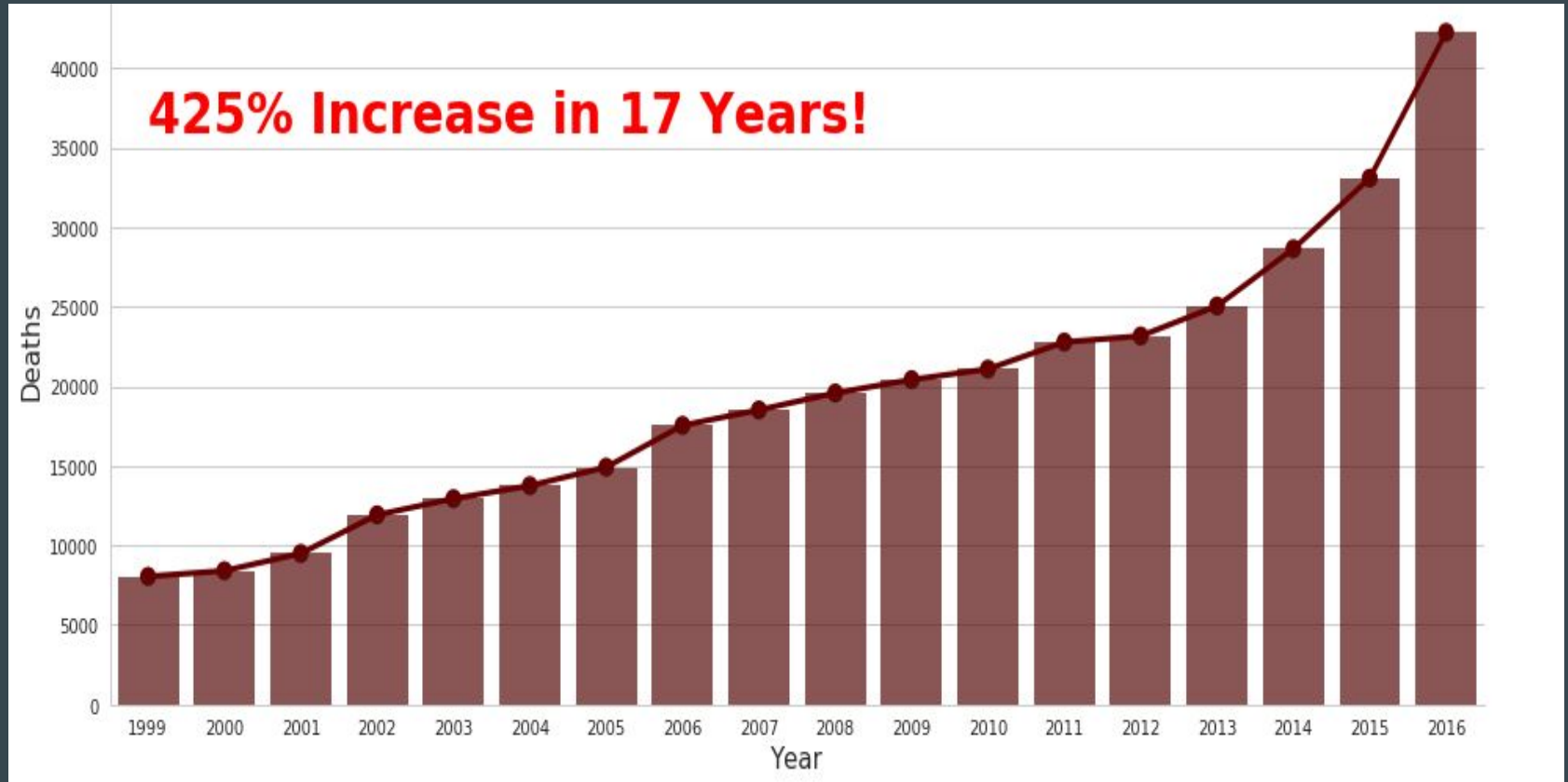


Predicting Opioid Prescription Rate By County

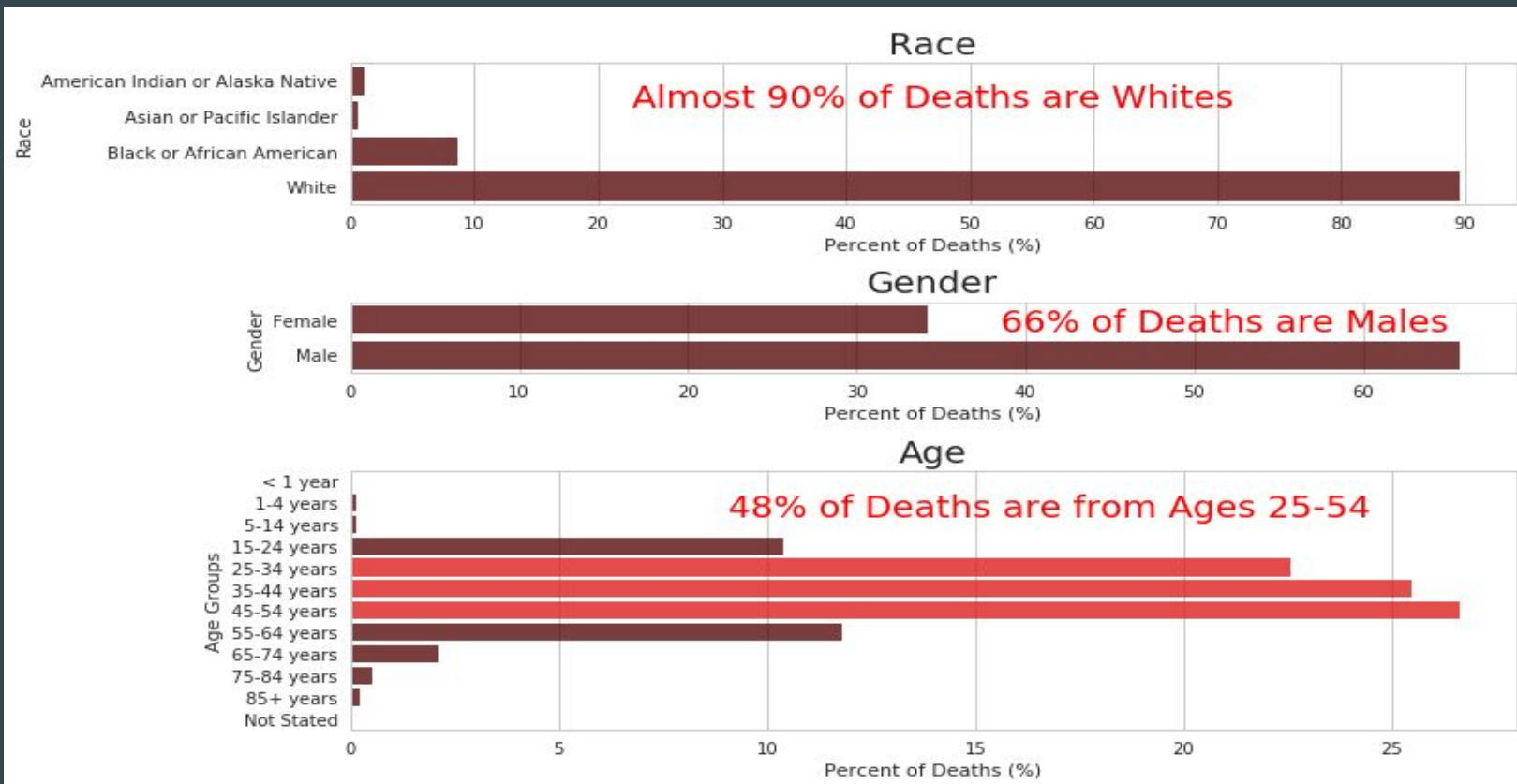
...

Daniel Lee
August 7, 2018

Annual Cause of Death by Opioid Overdose



Number of Deaths by Demographic Factors 1999 - 2016



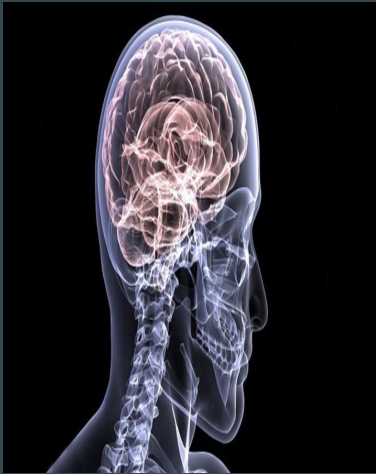
Living With An Opioid Addiction



Why We Should Care

- Not represented in the death numbers are those who are struggling with opioid addiction
- Addiction to opioids, like any other addictions, leads to

- Health Problems



- Financial Problems



- Relational Problems



What is the opioid epidemic?

- Wikipedia defines the opioid epidemic as the following:
 - Rapid increase in the use of prescription and non-prescription opioid drugs in the United States and Canada beginning in the late 1990s and continuing throughout the next two decades.¹

¹Source: https://en.wikipedia.org/wiki/Opioid_epidemic

Opioids

- Diverse class of moderately strong painkillers

- Oxycodone



- Hydrocodone (Vicodin)



- Fentanyl



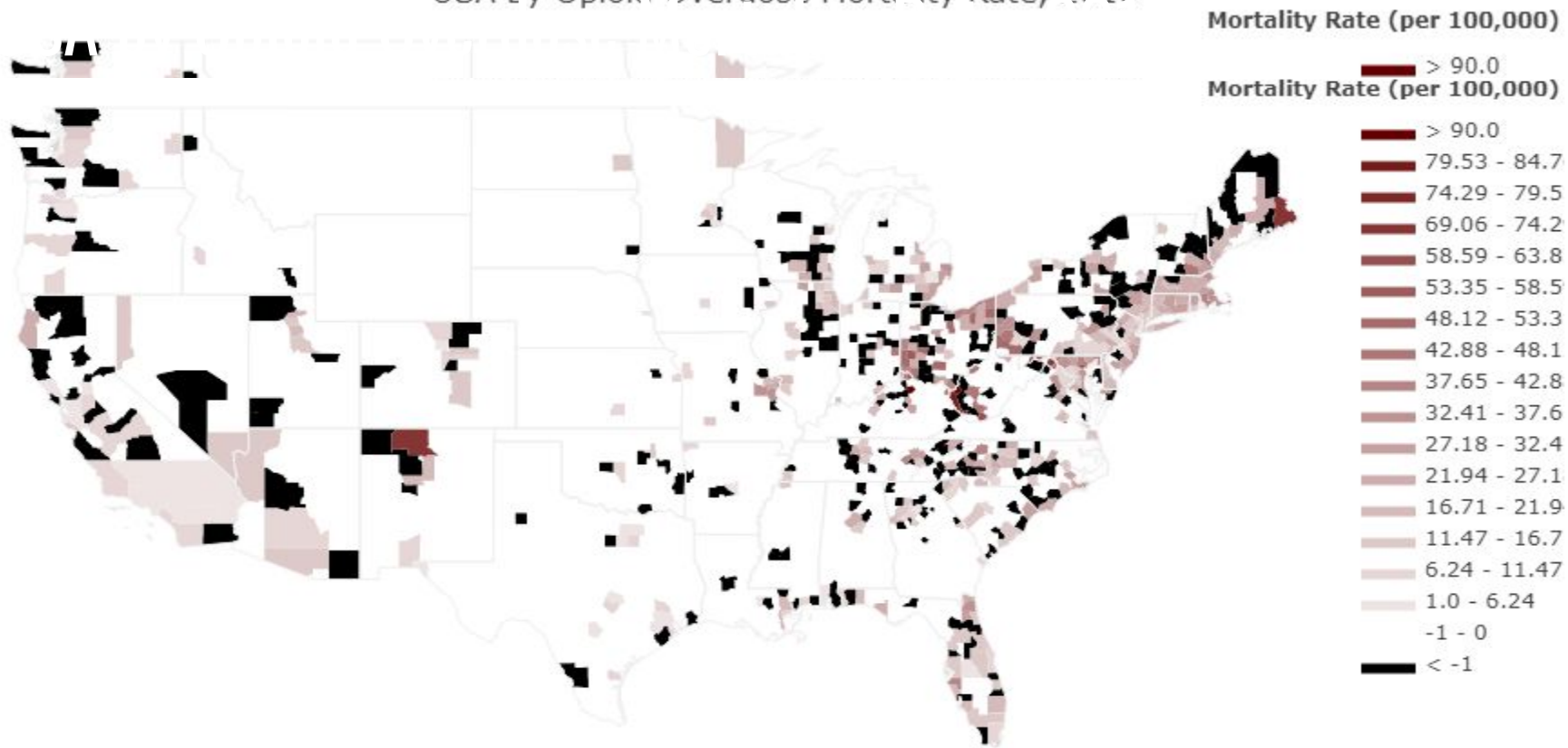
Problem

- In what county will the problem be worse?
 - Useful to help allocate resources
 - Learn more about causes of opioid overdose
 - Make biggest impact

Problem

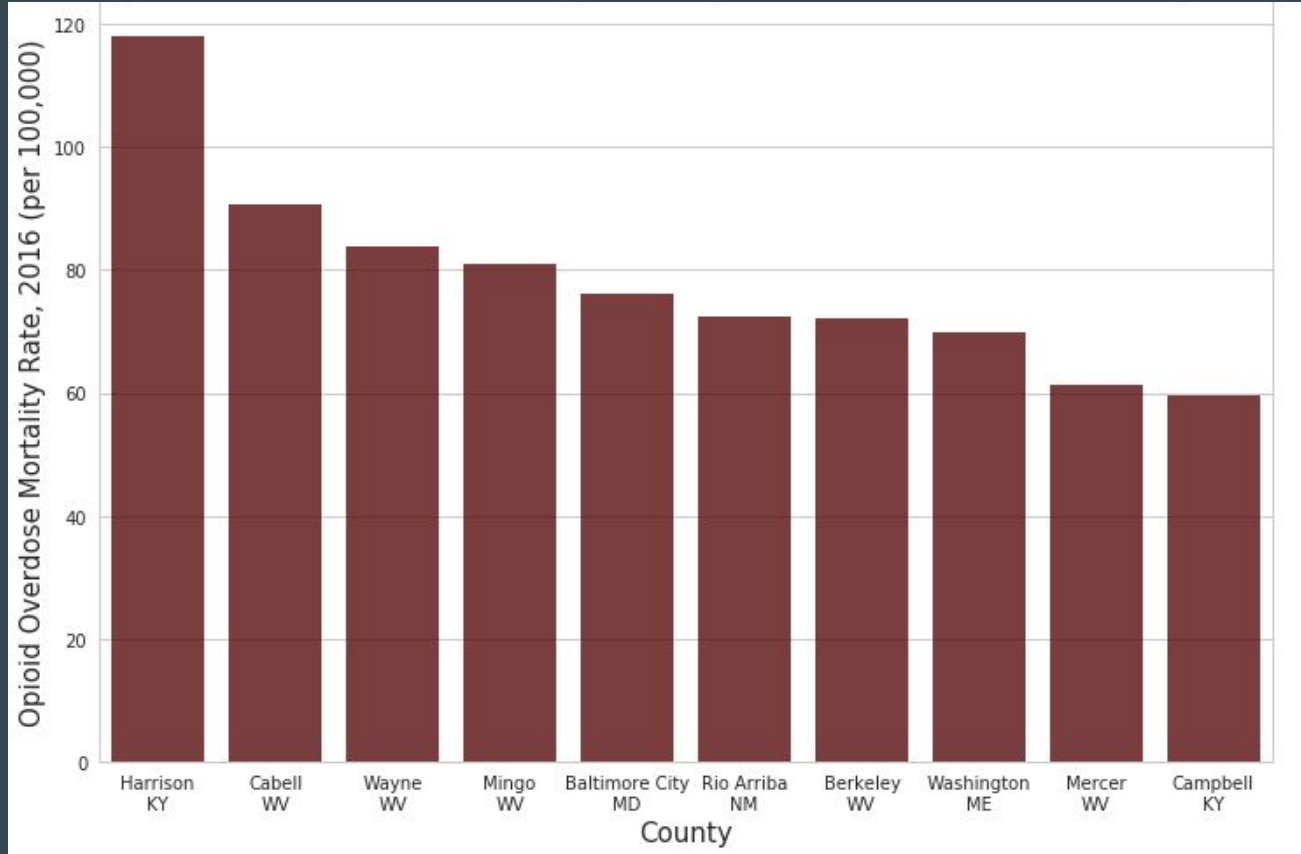
- Predict the county's mortality rate caused by drug overdose for 2016 given various independent variables
 - County's median household income
 - Population estimates
 - Unemployment
 - Poverty rate estimates
 - Educational attainment
 - Opioid prescription rate

USA by Opioid Overdose Mortality Rate, 2016



Note: Counties with missing values and unreliable values are shown as black.

Top Ten Counties with Highest Opioid Overdose Mortality Rate



County with Highest Mortality Rate Due to Opioid Addiction

- Highest county: **Harrison, KY**
 - 118 deaths per 100,000 people due to opioid overdose



Description of Data

- US County Opioid Prescribing Rates 2016
 - <https://www.cdc.gov/drugoverdose/maps/rxcounty2016.html>
- Unemployment, median household income, educational attainment, poverty rate estimates, and population estimates:
 - <https://www.ers.usda.gov/data-products/county-level-data-sets/download-data/>
- Underlying Cause of Death
 - https://raw.githubusercontent.com/danielhanbitlee/Springboard/master/capstone_project/drug_overdose_death_opioid_2016.txt
 - <https://wonder.cdc.gov/controller/saved/D77/D39F042>
 - Note that statistics representing zero to nine deaths are suppressed at the region, state and county level.

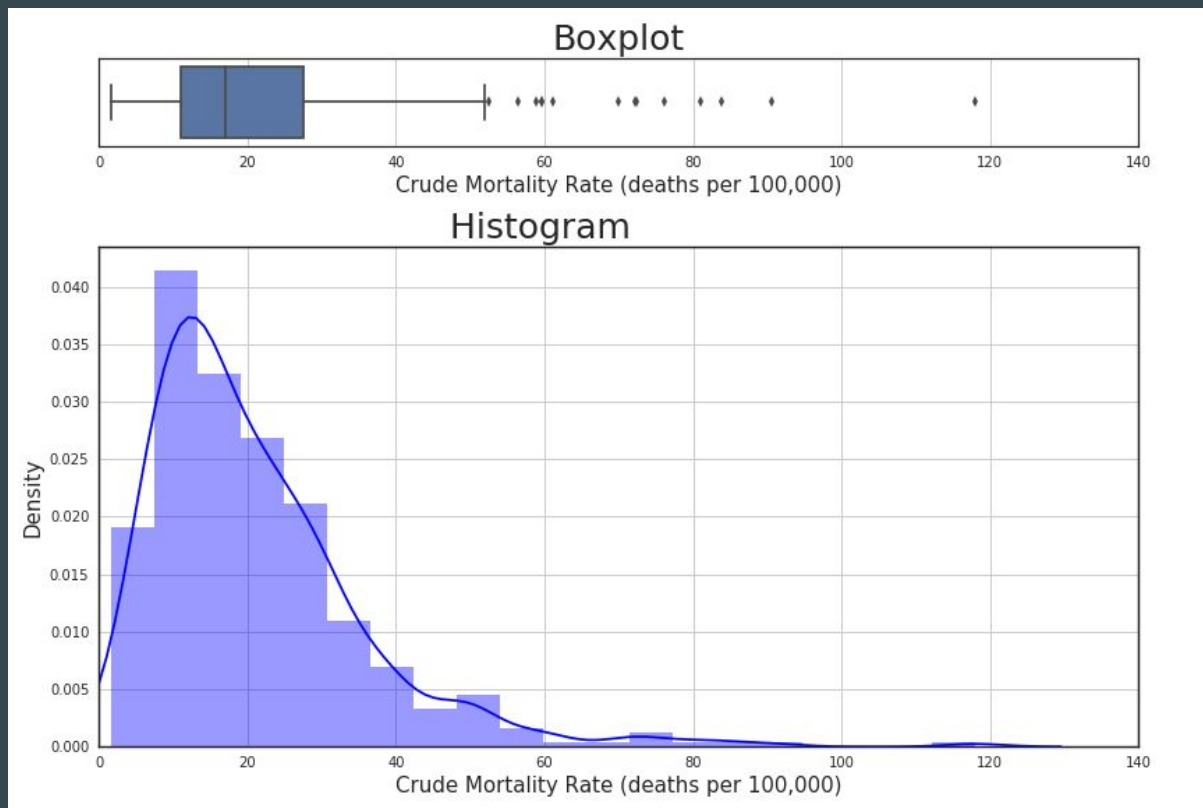
Crude Opioid Mortality Rate

- **crude_opioid_mortality_rate** - Estimated rate for deaths caused by opioid overdose in the county for 2016 (per 100,000 people)
 - Specifically, the types of drug-related deaths include the following:
 - Drug poisonings (overdose)
 - Unintentional
 - Suicide
 - Homicide
 - Undetermined
 - The specific drugs included in the death rates are the following:
 - Opium
 - Heroin
 - Other opioids
 - Methadone
 - Other synthetic narcotics
 - Other and unspecified narcotics

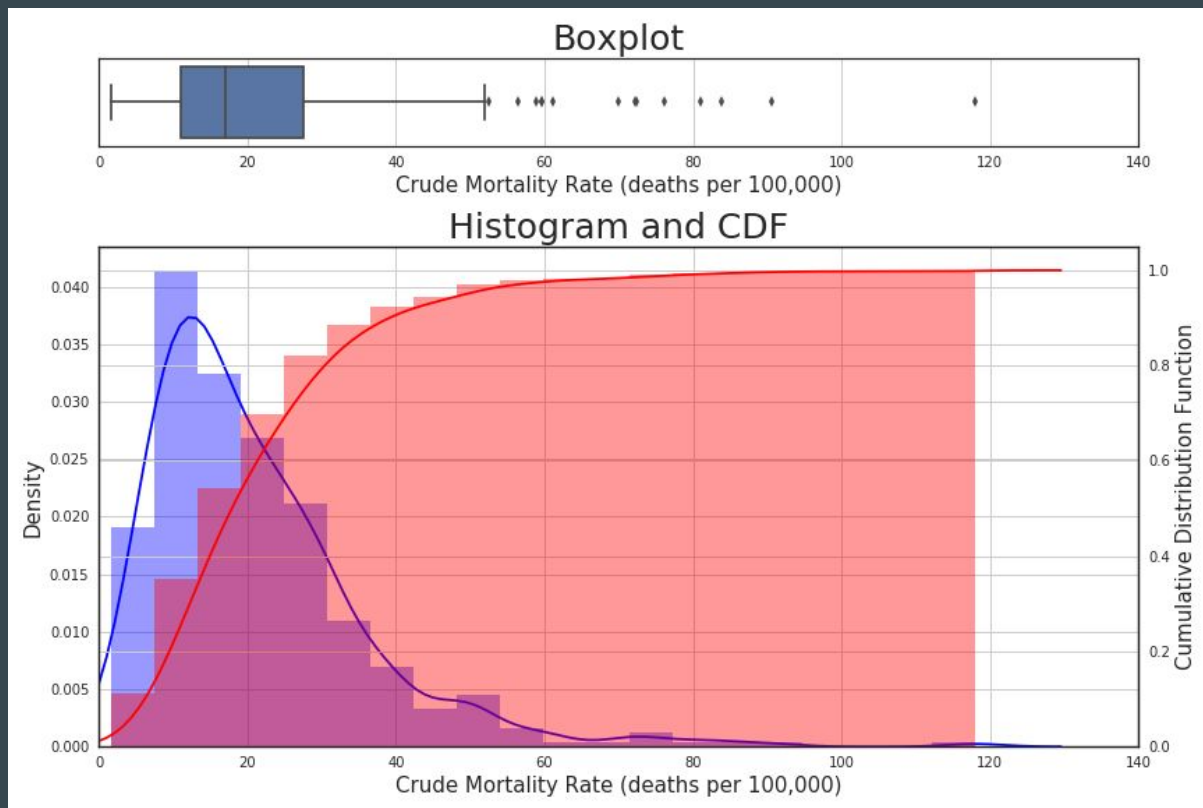
Distribution of County Level Opioid Overdose Mortality Rate



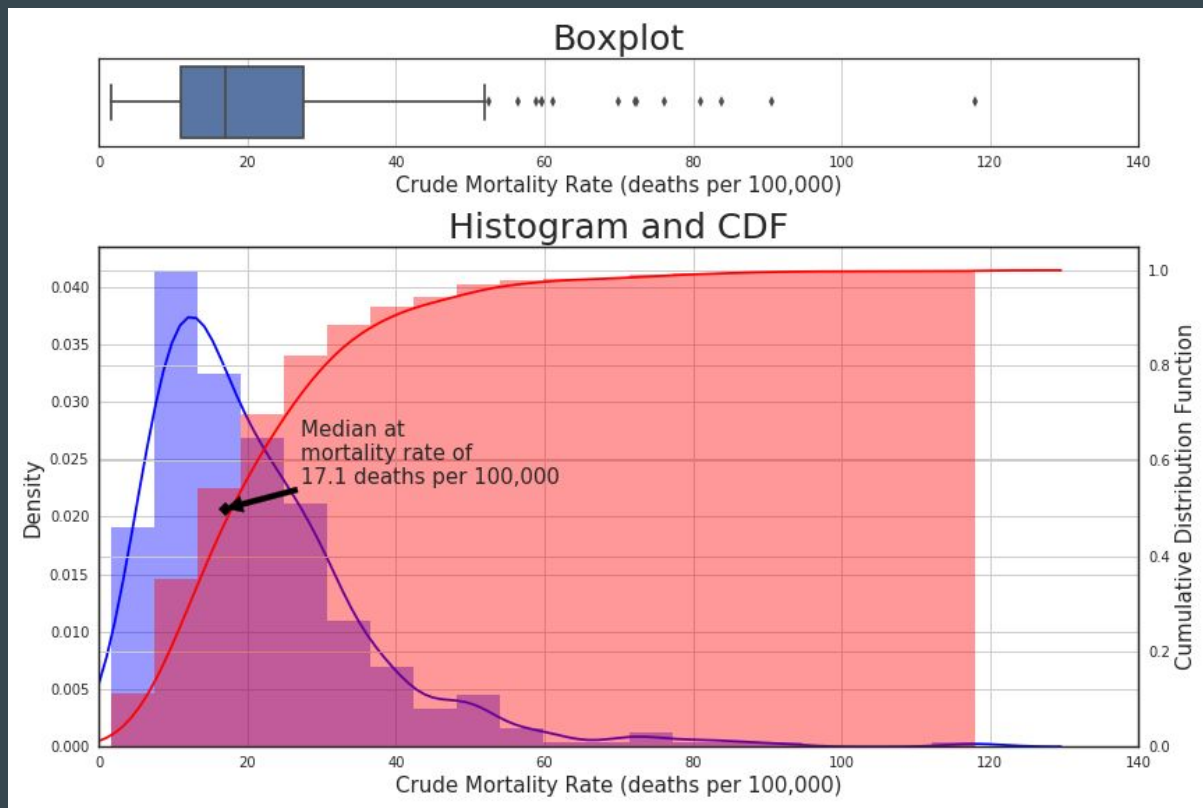
Distribution of County Level Opioid Overdose Mortality Rate



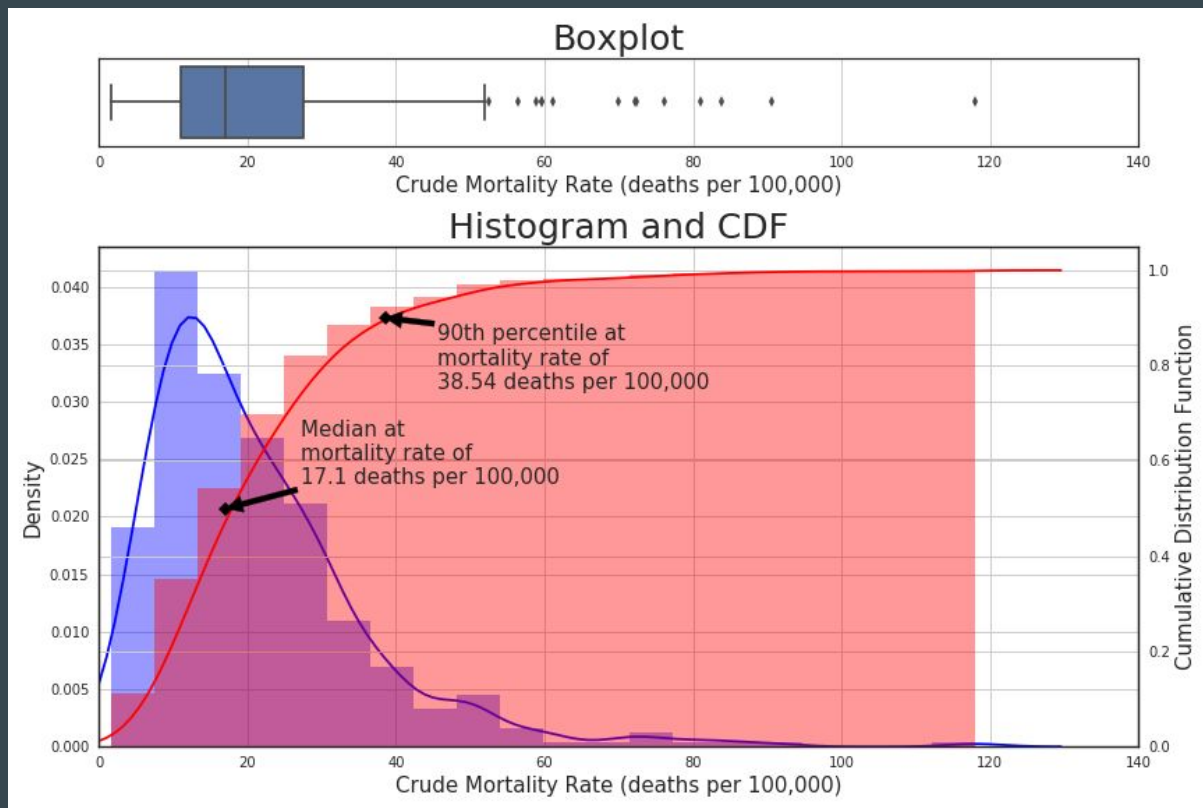
Distribution of County Level Opioid Overdose Mortality Rate



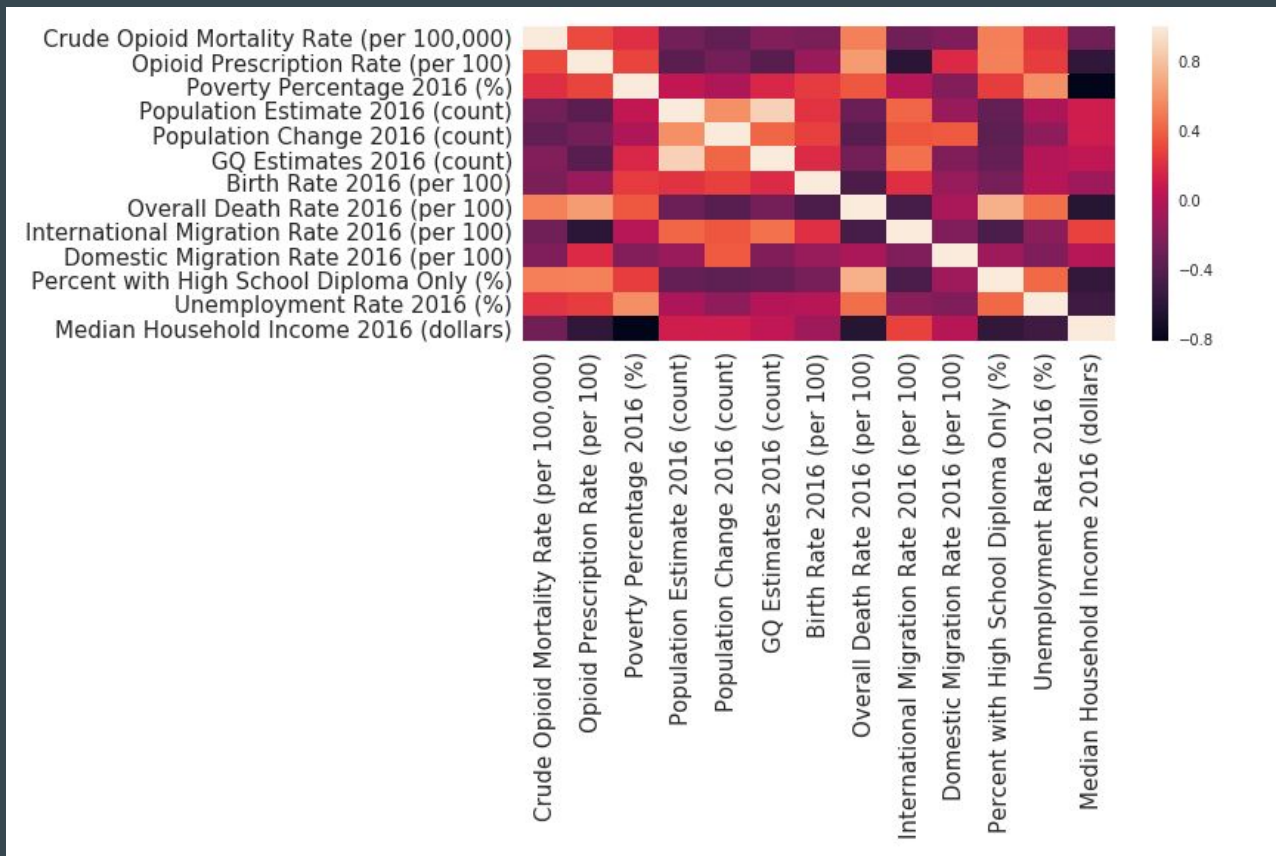
Distribution of County Level Opioid Overdose Mortality Rate



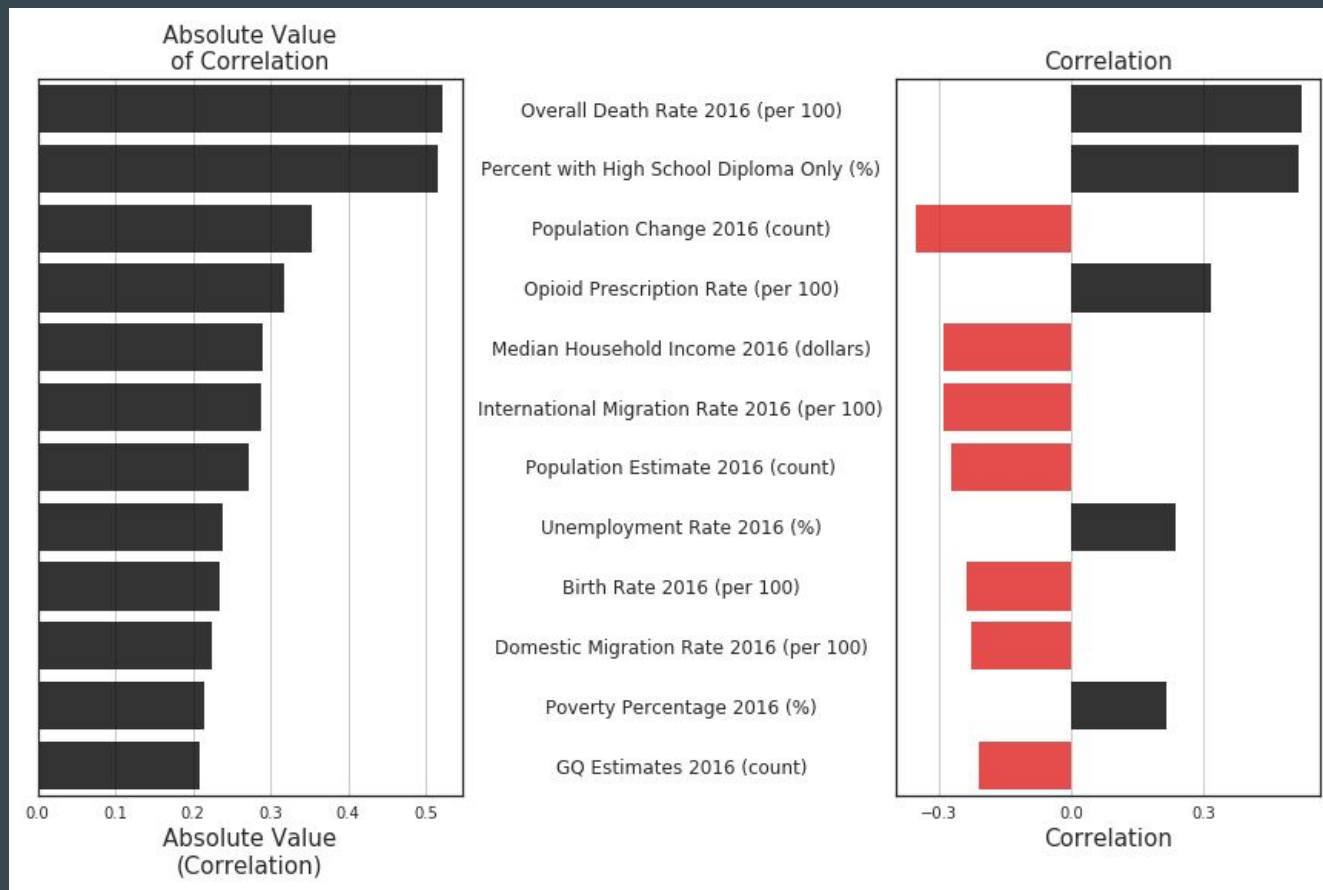
Distribution of County Level Opioid Overdose Mortality Rate



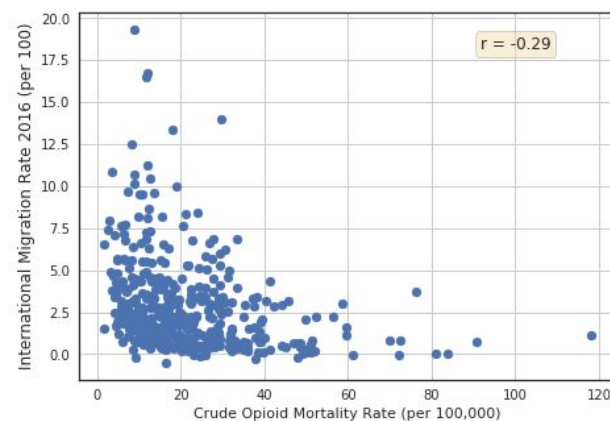
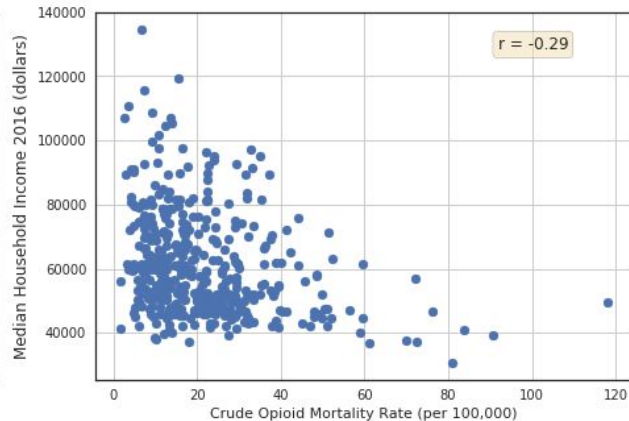
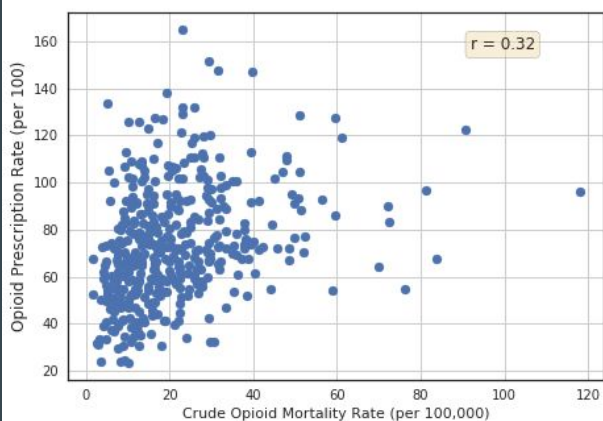
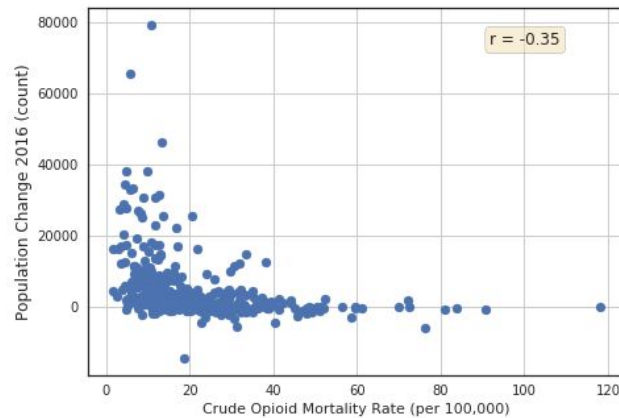
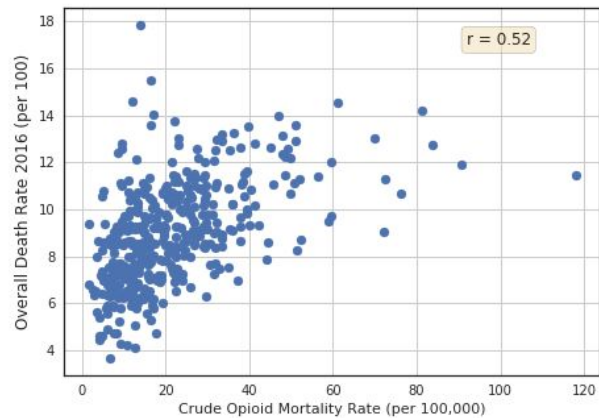
Correlation Heat Map of All the Variables



Pearson's Correlation Between Crude Mortality Rate and All Other Variables



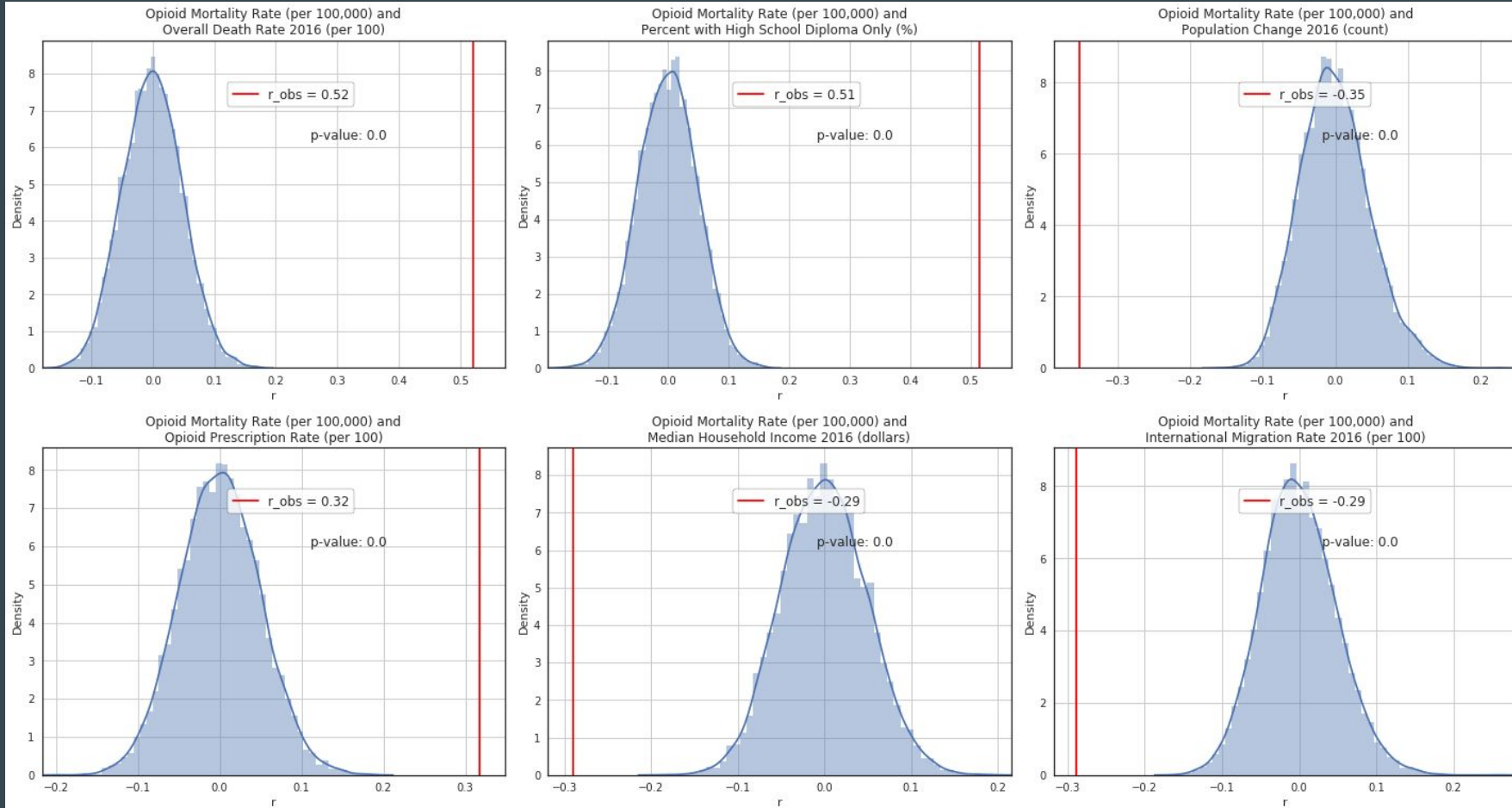
Scatter Plots of Crude Opioid Mortality Rate and Other Variables



Crude Opioid Mortality Rate

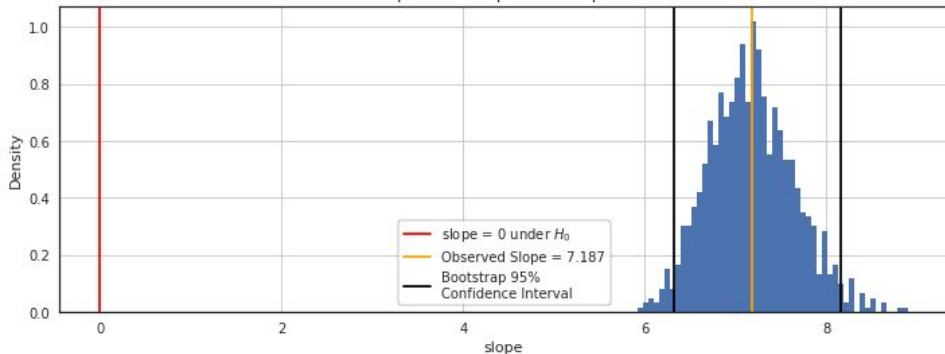
- Most correlated with the following three predictors:
 - a. Overall Death Rate 2016 (per 1000) ($r = 0.52$)
 - Overall death rate (all causes, not only caused by opioid overdose) in period 7/1/2015 to 6/30/2016 (per 1000 people)
 - b. Percent with High School Diploma Only ($r = 0.51$)
 - Estimated percent of people with high school diploma only (%)
 - c. Population Change 2016 (count) ($r = -0.35$)
 - Net change in resident total population 7/1/2015 to 7/1/2016 (number of people)

Hypothesis Test of Correlation By Permuting Samples - Distribution of Correlation Values

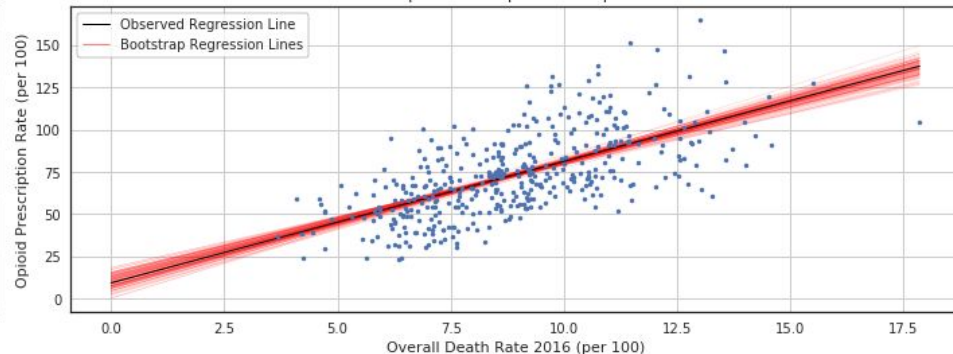


Linear Regression and Confidence Interval Using Pairs Bootstrap

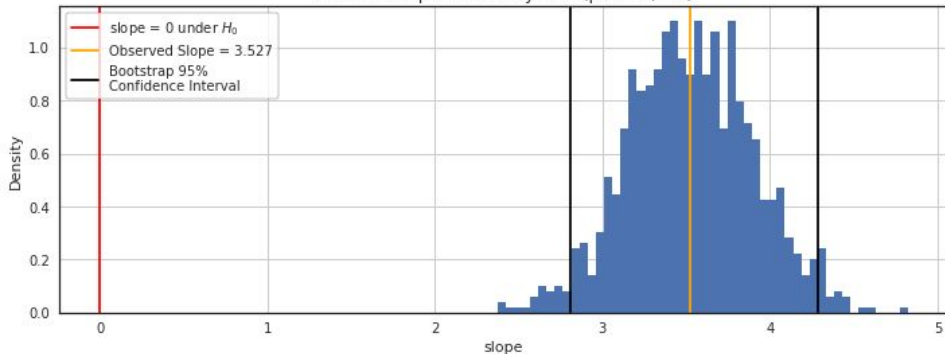
Bootstrap Sampling Distribution of the Slope
of Regression Line for Overall Death Rate 2016 (per 100)
and Opioid Prescription Rate (per 100)



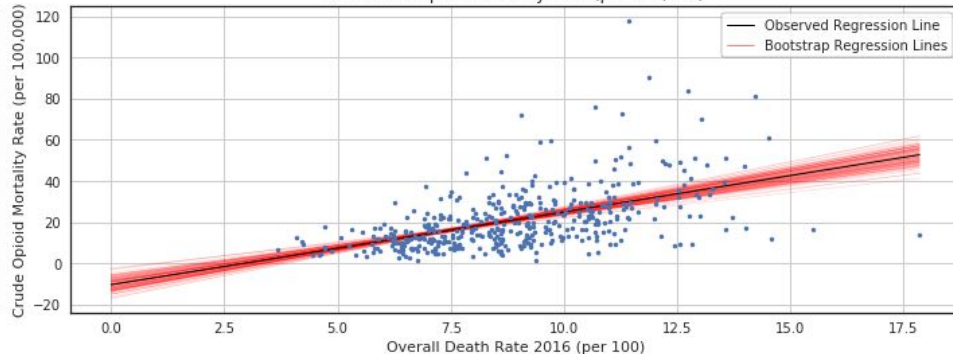
Observed Regression Line, Bootstrap Regression Lines
and Scatter Plot of Overall Death Rate 2016 (per 100)
and Opioid Prescription Rate (per 100)



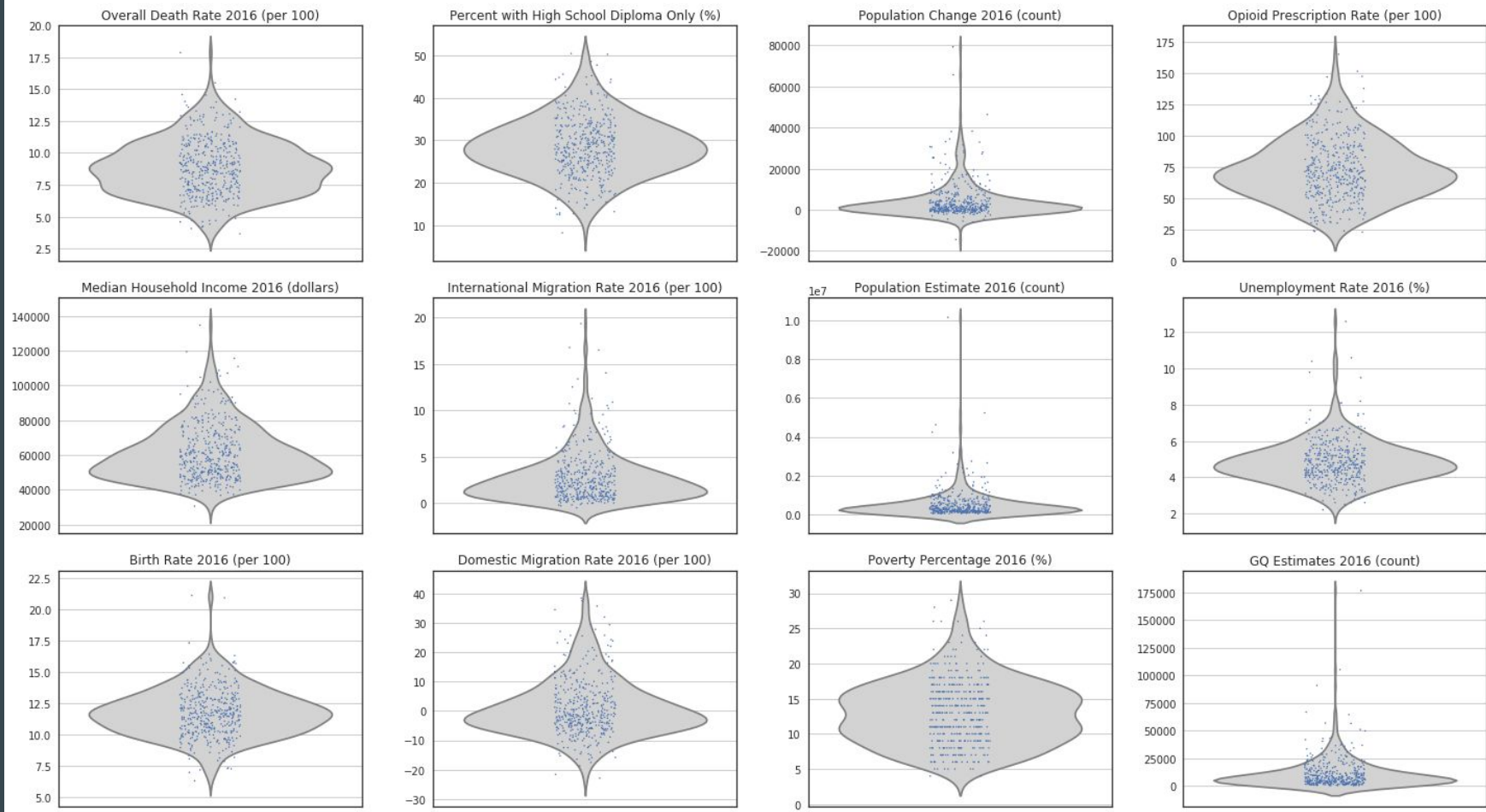
Bootstrap Sampling Distribution of the Slope
of Regression Line for Overall Death Rate 2016 (per 100)
and Crude Opioid Mortality Rate (per 100,000)



Observed Regression Line, Bootstrap Regression Lines
and Scatter Plot of Overall Death Rate 2016 (per 100)
and Crude Opioid Mortality Rate (per 100,000)



Violin Plots of All Variables Except Crude Mortality Rate



Conclusion From Exploratory Data Analysis

- Counties with higher opioid addiction mortality rates caused by opioid addiction have
 - Higher overall mortality rate
 - Have more adults with high school diplomas only
 - Higher opioid prescription rates
 - Decrease in population size in 2016
 - Lower median household income
- Possible reasons for these correlations
 - Population in these counties are older
 - These counties may not have good access to healthcare for the residents

Conclusion From Exploratory Data Analysis

- Further research
 - Why do counties that have high percentage of the population with only high school diplomas have high opioid overdose mortality rate?
 - Possibly population in these counties are older
 - Possibly people in these counties may not have access to higher education for some reason