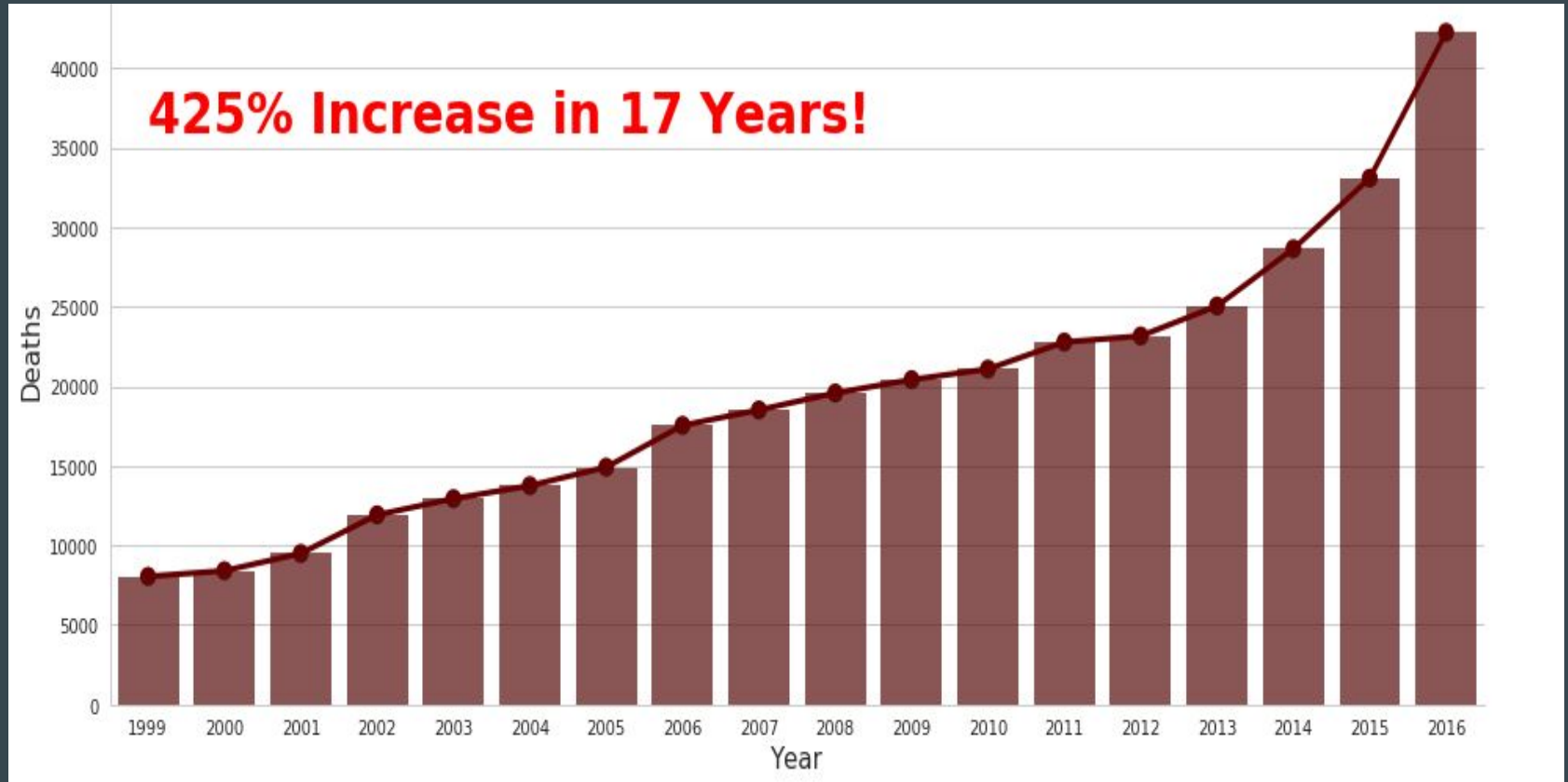


# Predicting Opioid Prescription Rate By County

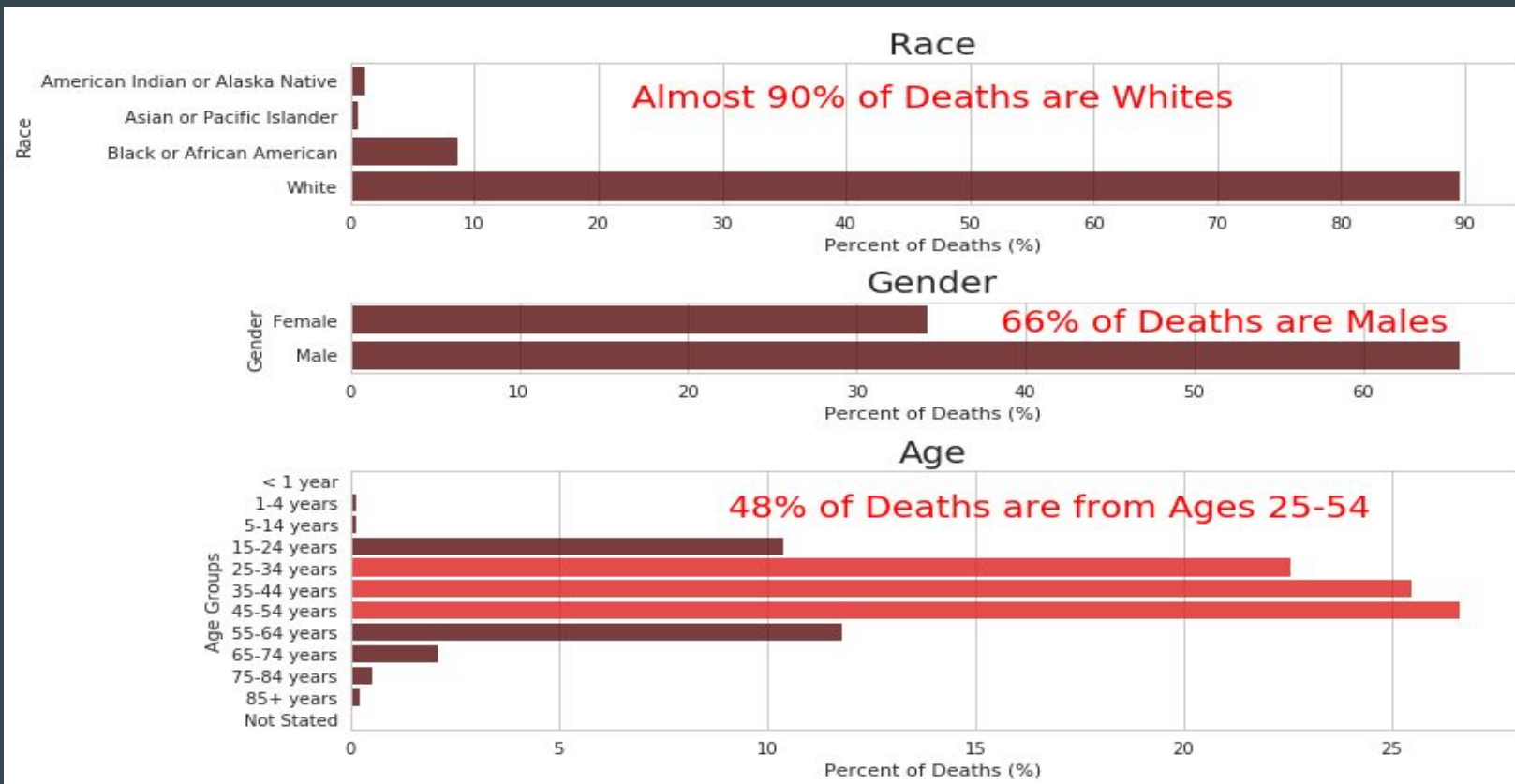
...

Daniel Lee  
August 7, 2018

# Annual Cause of Death by Opioid Overdose



# Number of Deaths by Demographic Factors 1999 - 2016



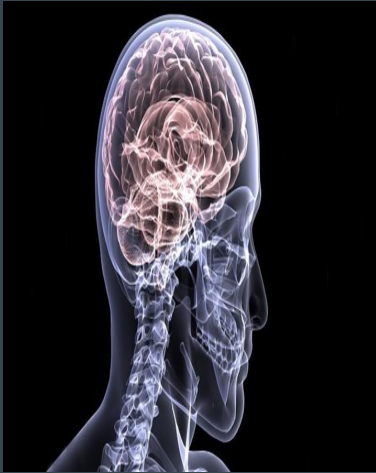
# Living With An Opioid Addiction



# 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. <sup>1</sup>

<sup>1</sup>Source: [https://en.wikipedia.org/wiki/Opioid\\_epidemic](https://en.wikipedia.org/wiki/Opioid_epidemic)

# Opioids

- Diverse class of moderately strong painkillers

- Oxycodone



- Hydrocodone (Vicodin)



- Fentanyl



# Problem

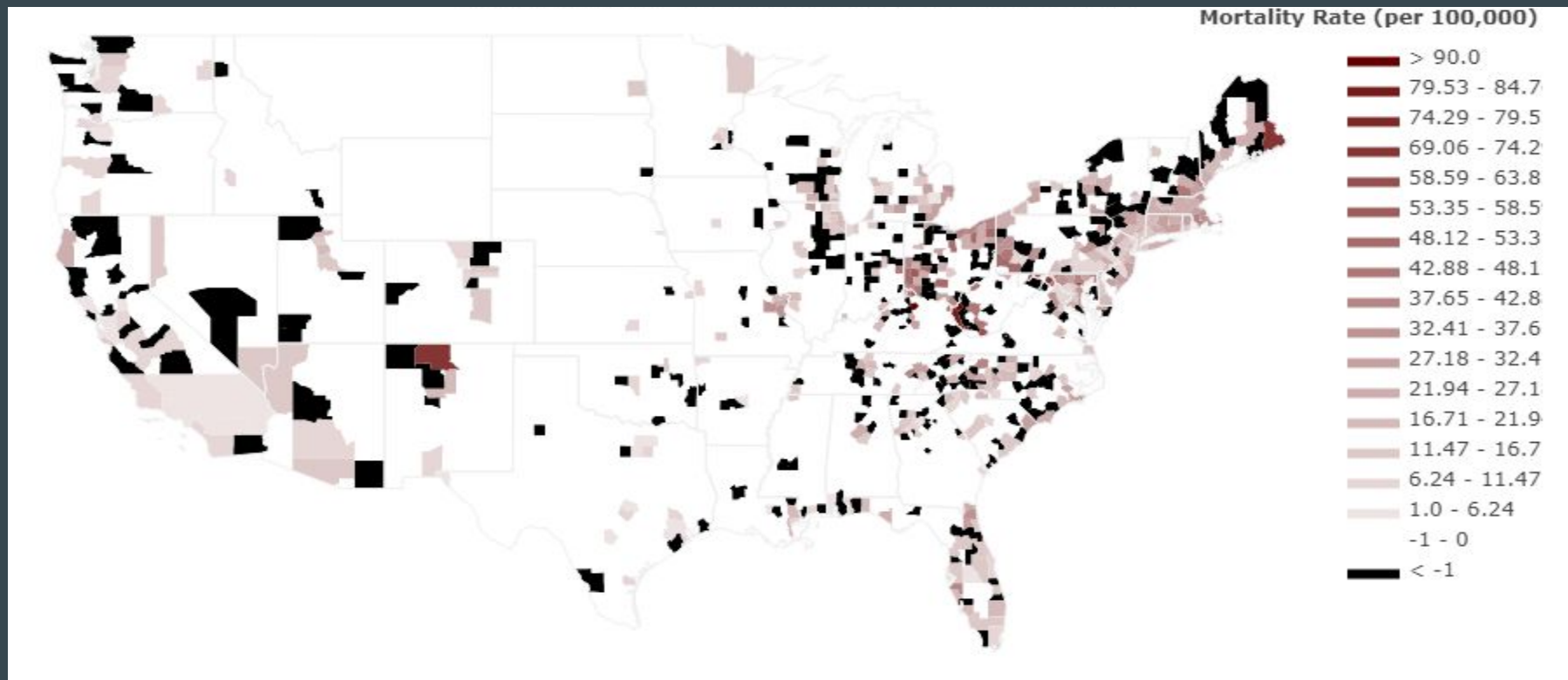
- In what county will the problem be worse?
  - Useful to help allocate resources
  - Learn more about causes of opioid overdose
  - Make biggest impact



# Problem

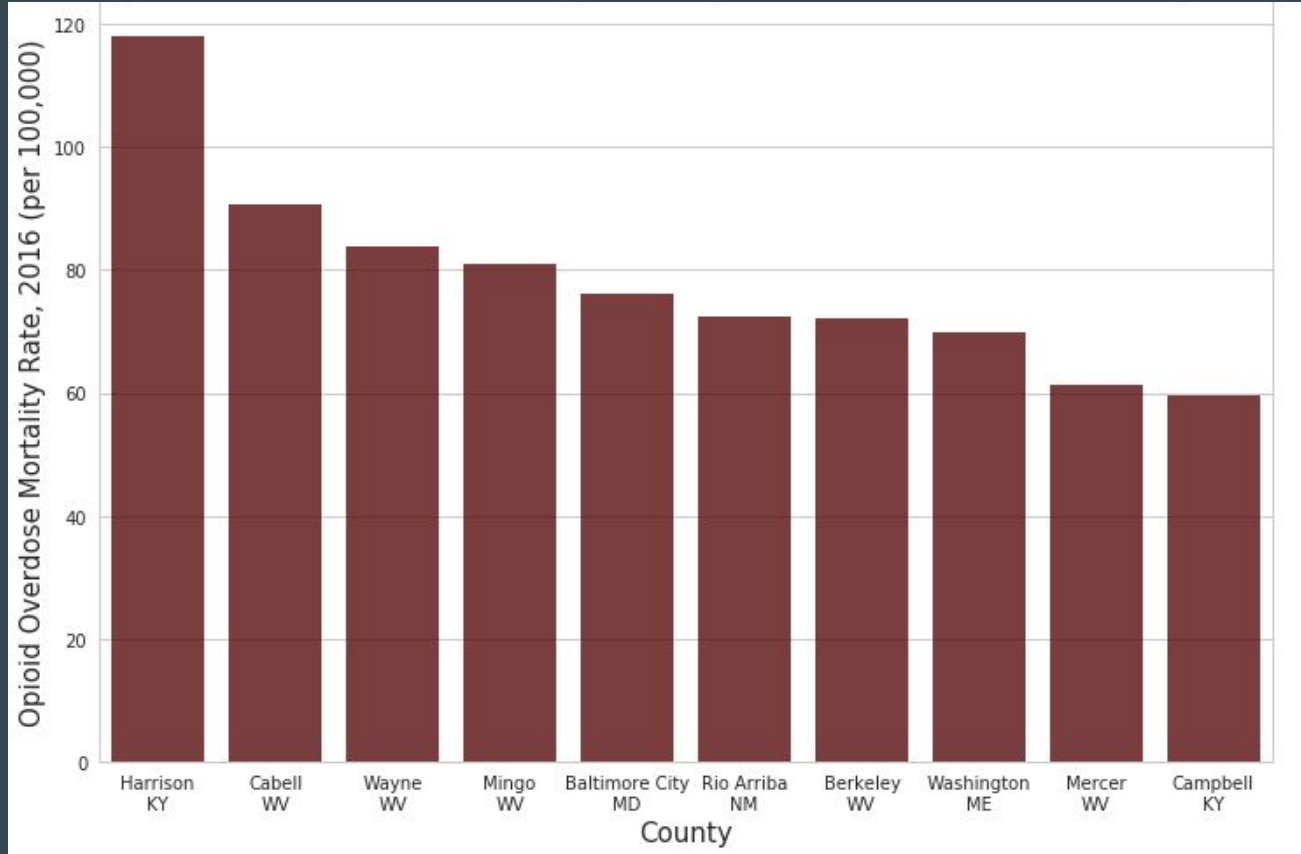
- Predict the county's mortality rate caused by drug overdose for 2016 given various independent variables
  - County's median household income
  - Population estimates
  - Unemployment
  - Poverty rate estimates
  - Educational attainment
  - Opioid prescription rate

# 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://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.

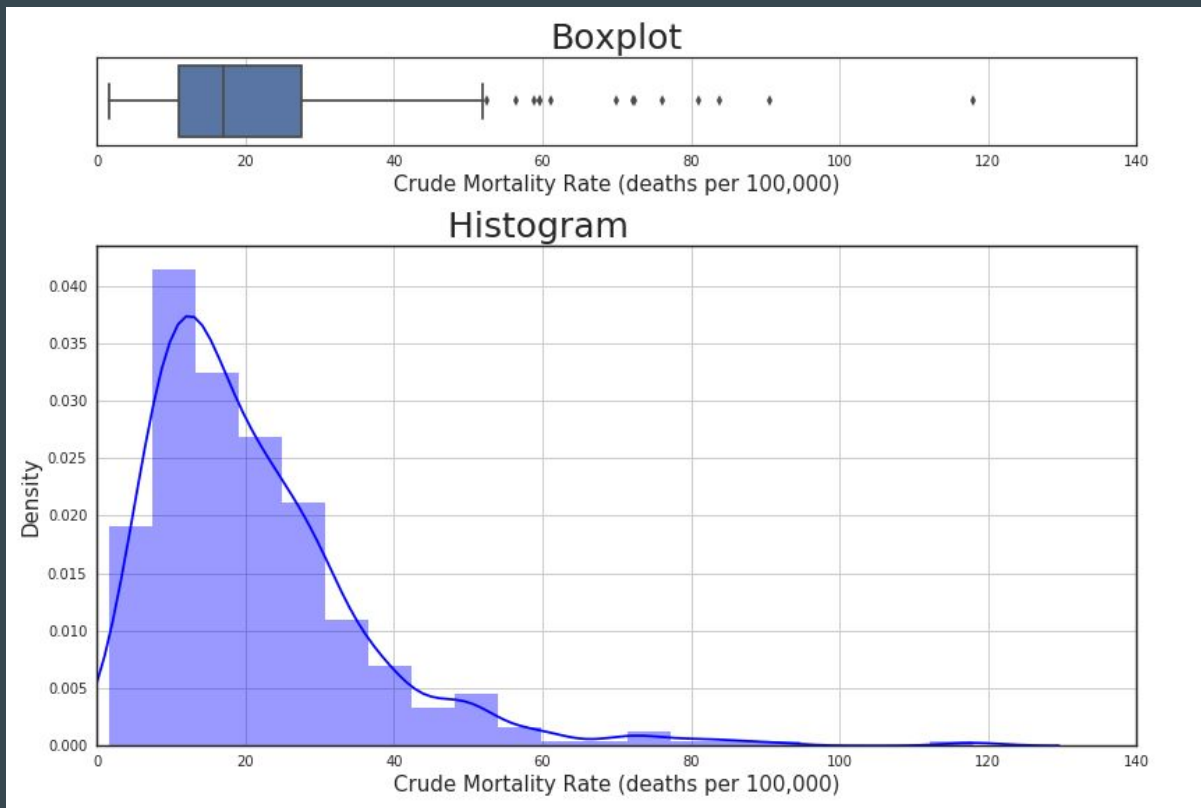
# Crude Opioid Mortality Rate

- **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

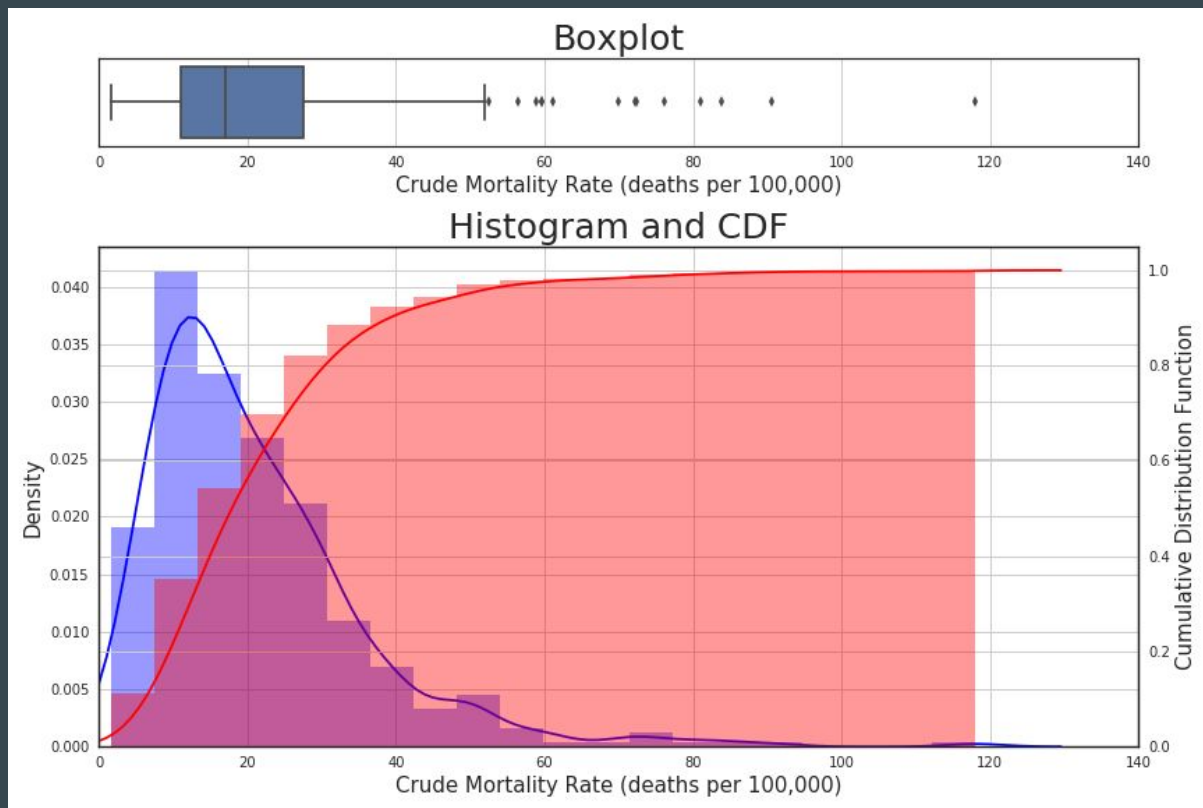


# Distribution of County Level Opioid Overdose Mortality Rate

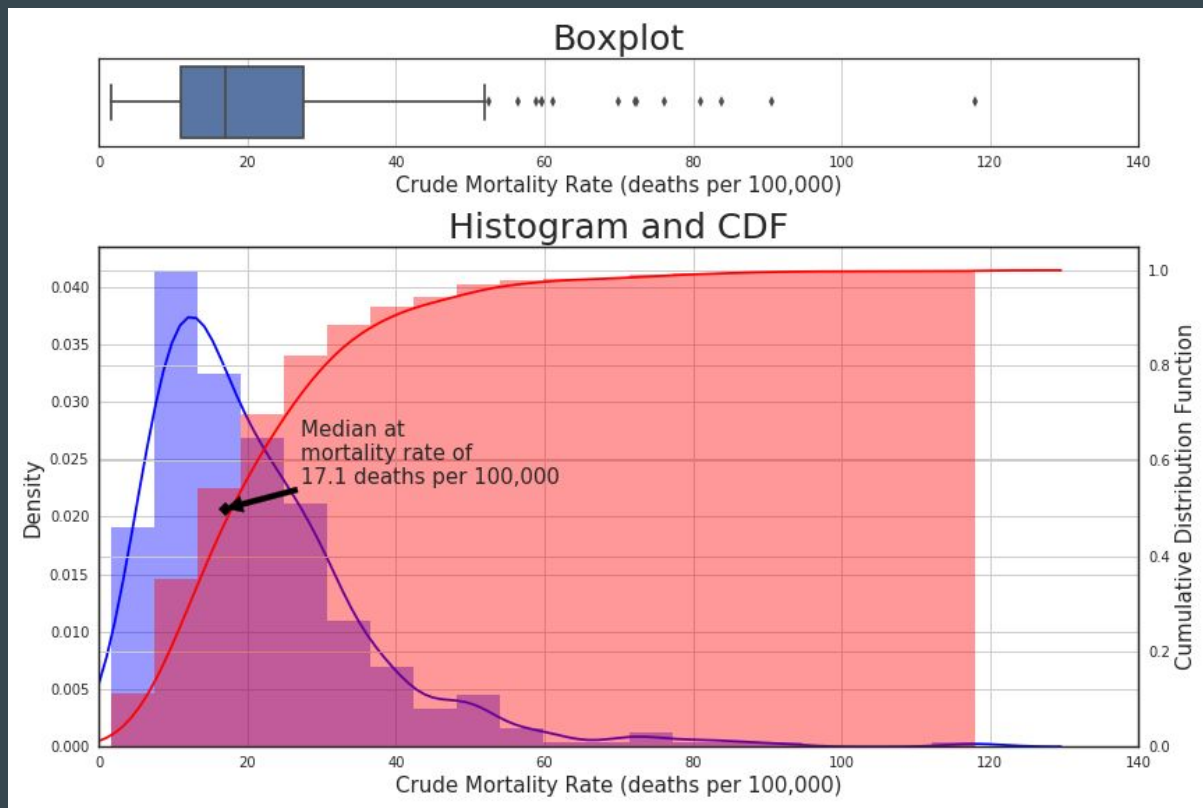




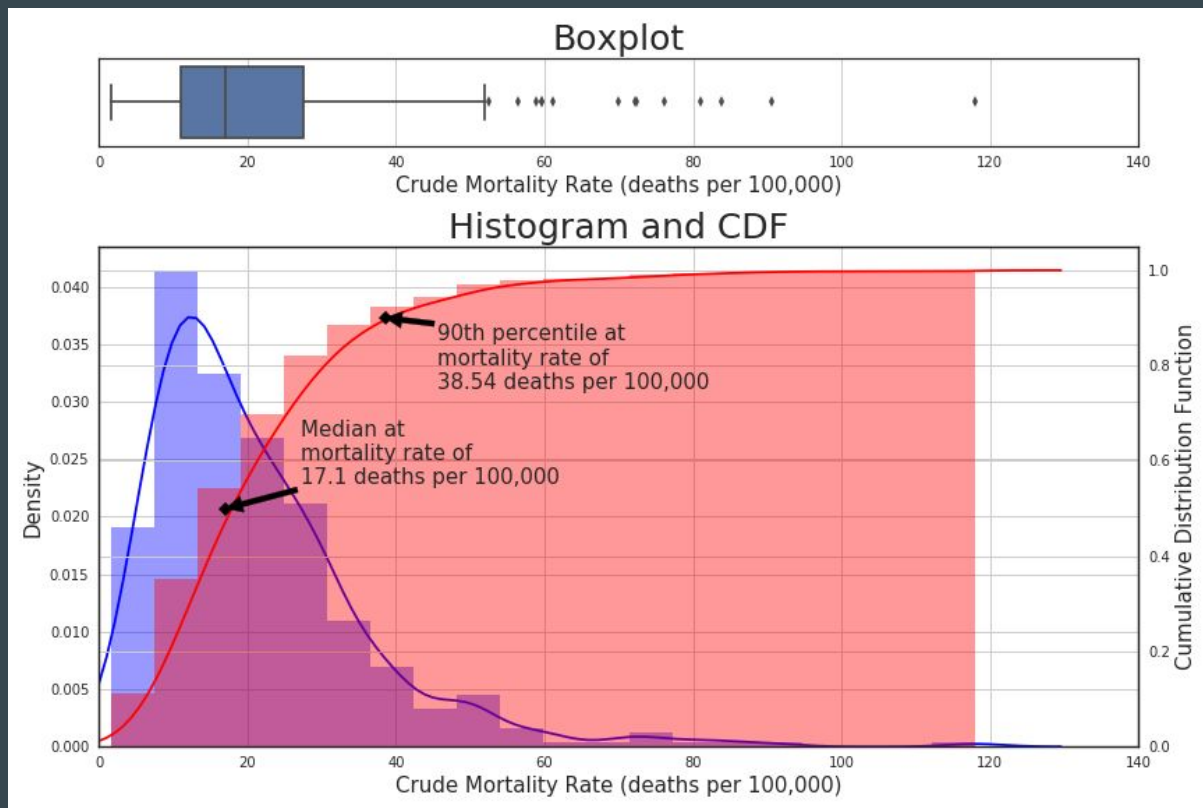
# Distribution of County Level Opioid Overdose Mortality Rate



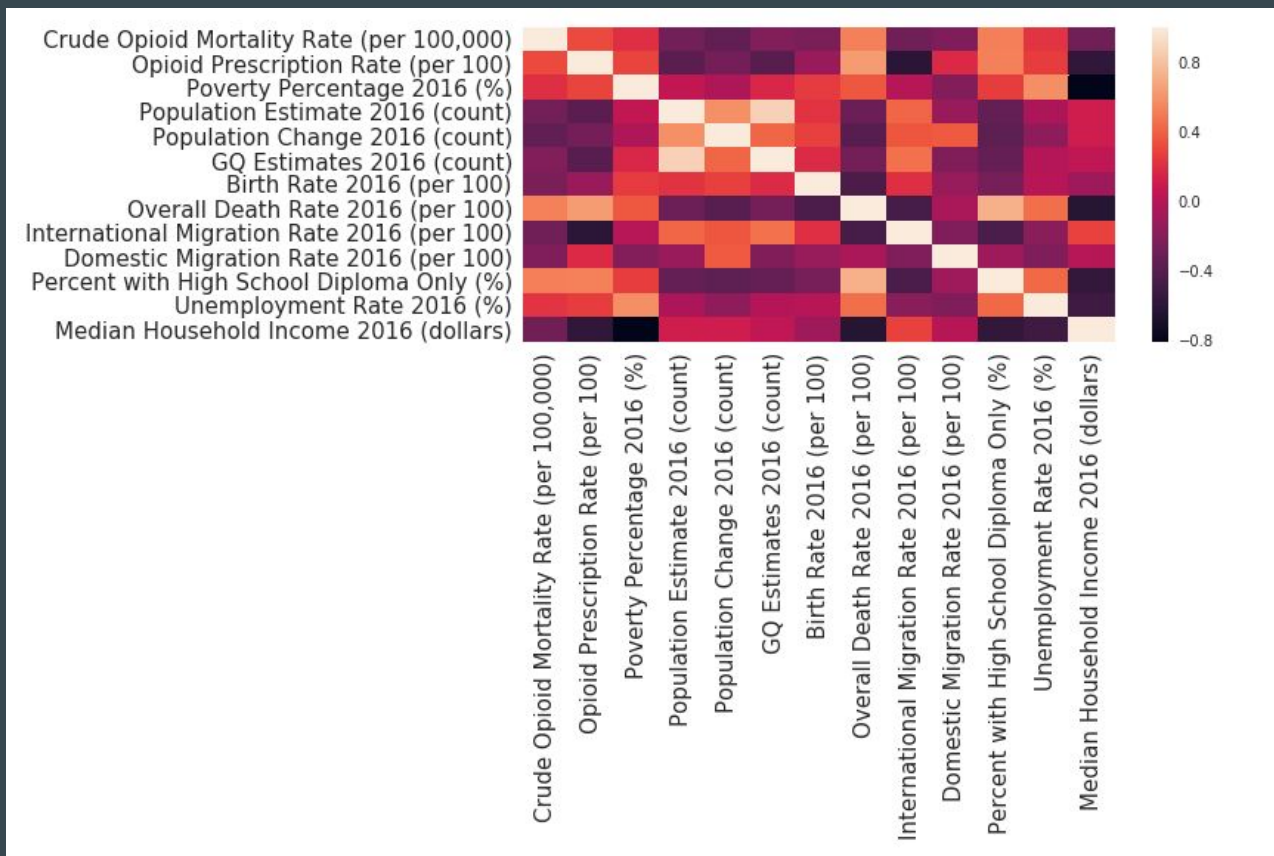
# Distribution of County Level Opioid Overdose Mortality Rate



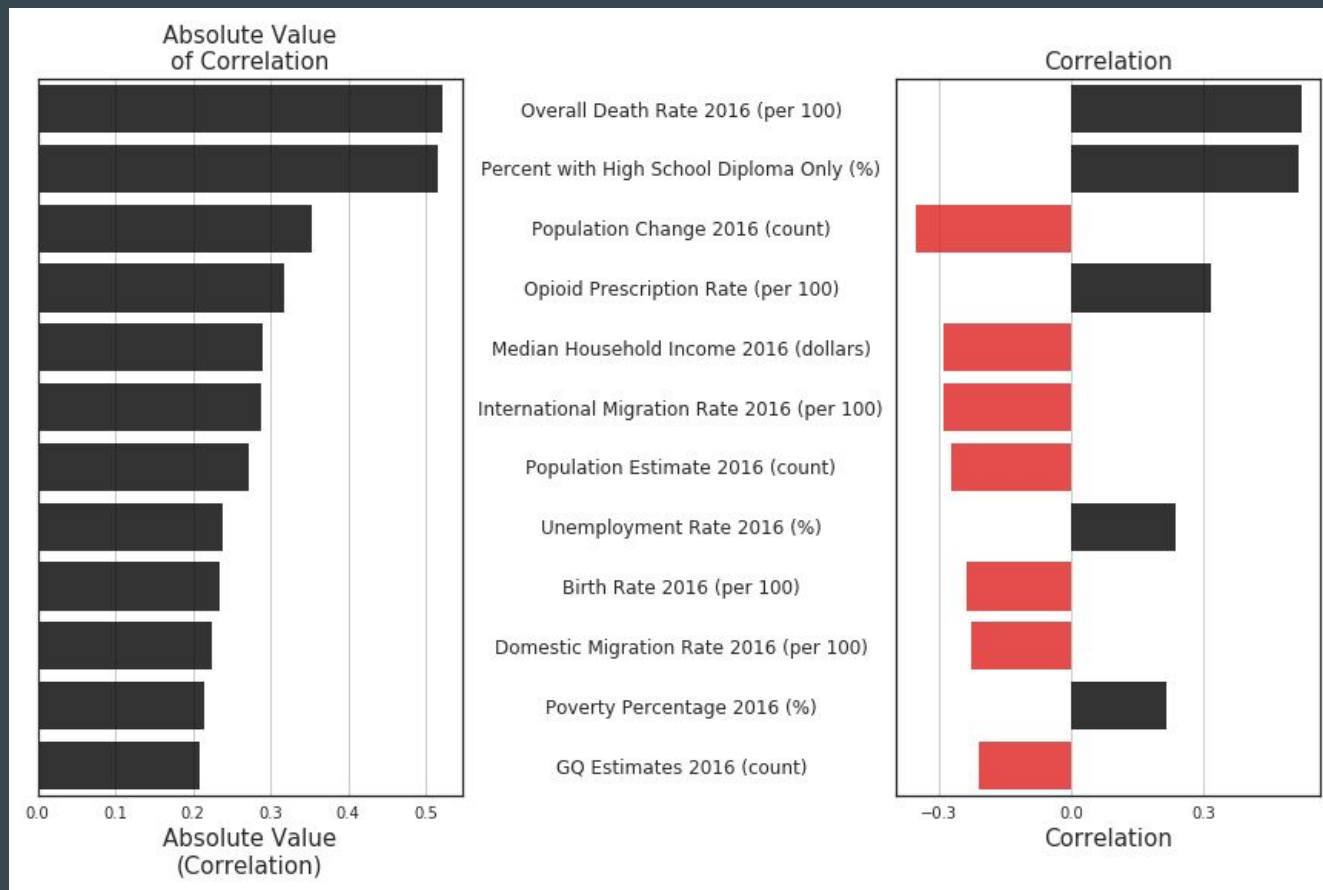
# Distribution of County Level Opioid Overdose Mortality Rate



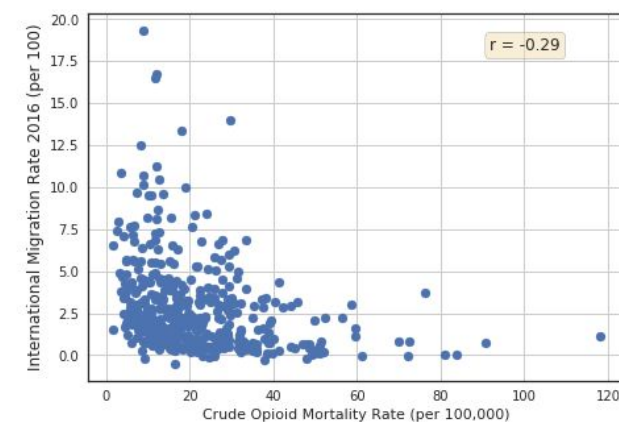
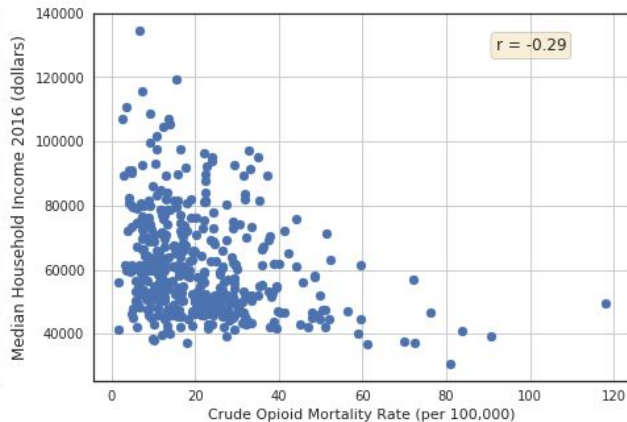
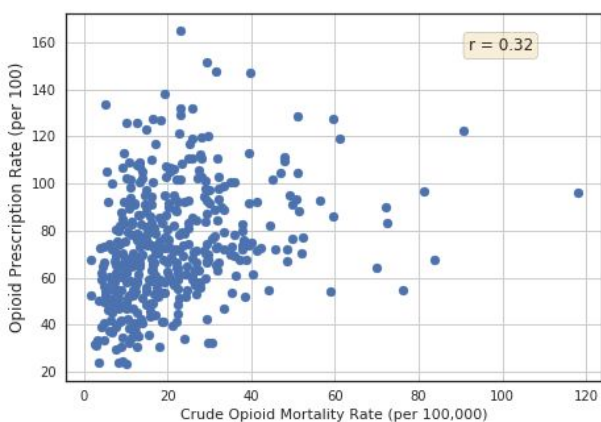
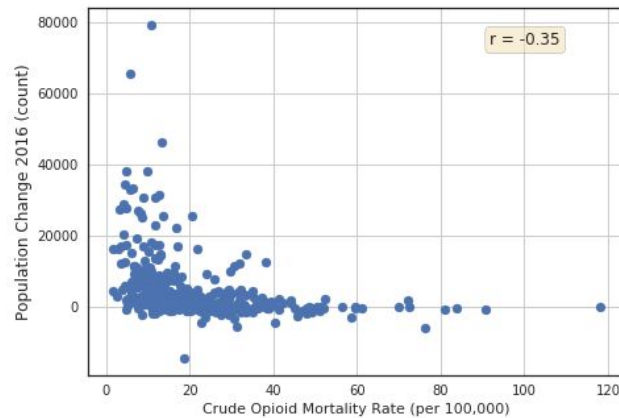
# Correlation Heat Map of All the Variables



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



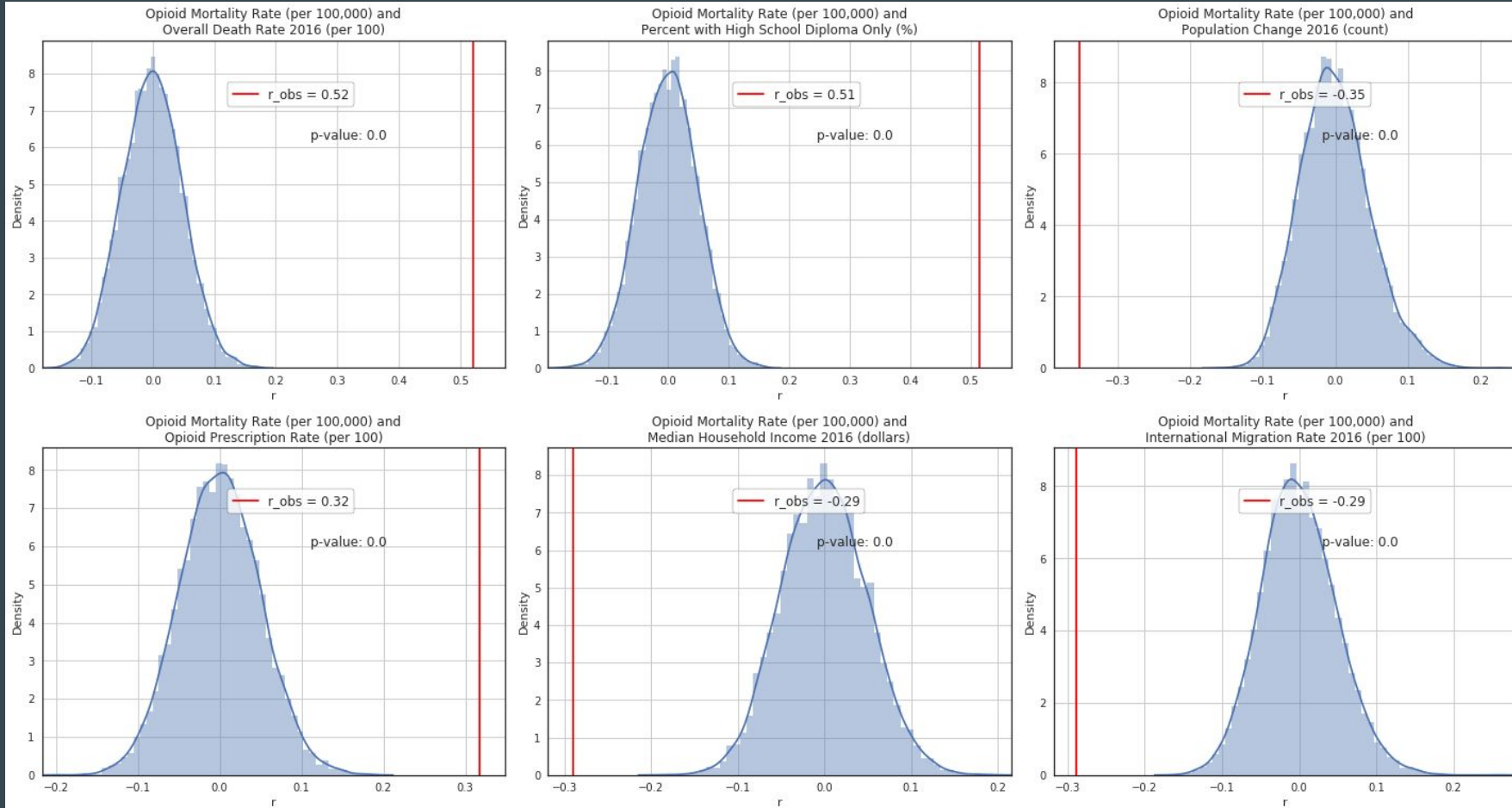
# Scatter Plots of Crude Opioid Mortality Rate and Other Variables



# 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)

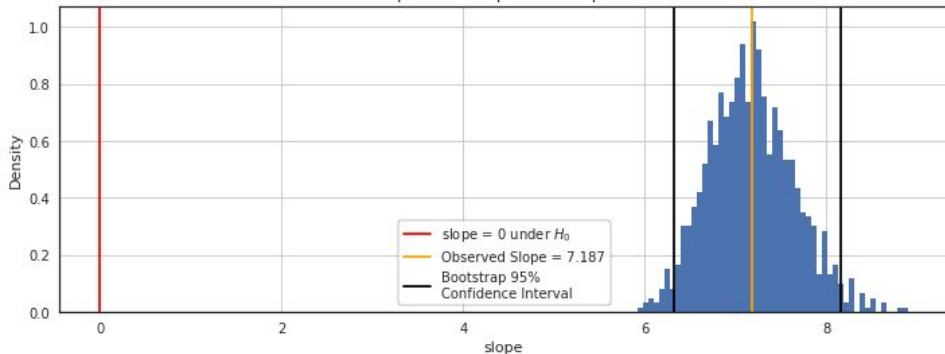
# Hypothesis Test of Correlation By Permuting Samples - Distribution of Correlation Values



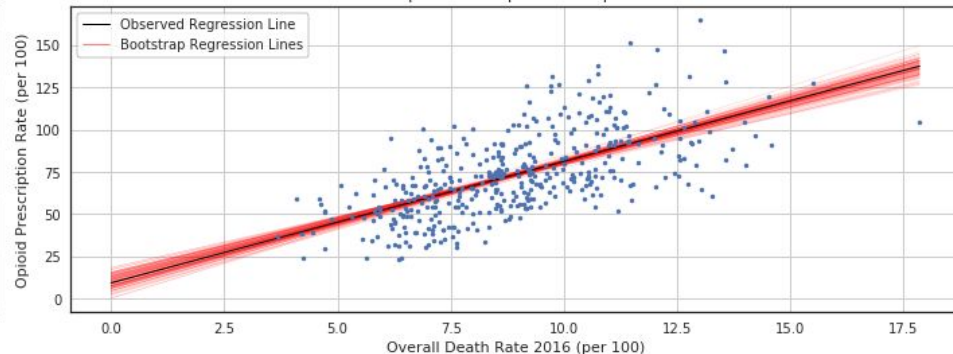


# Linear Regression and Confidence Interval Using Pairs Bootstrap

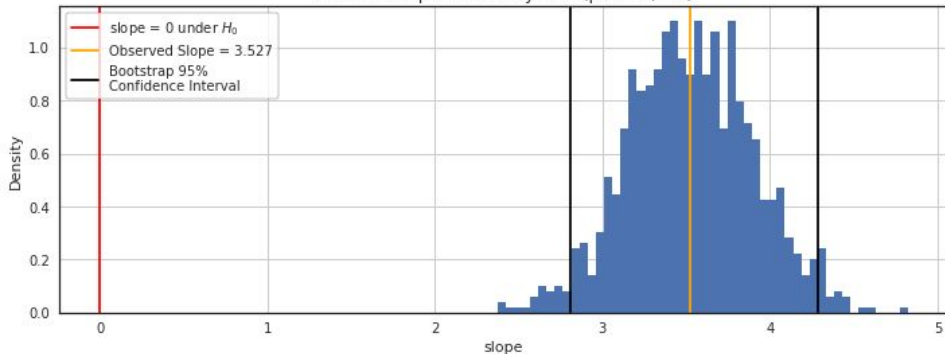
Bootstrap Sampling Distribution of the Slope  
of Regression Line for Overall Death Rate 2016 (per 100)  
and Opioid Prescription Rate (per 100)



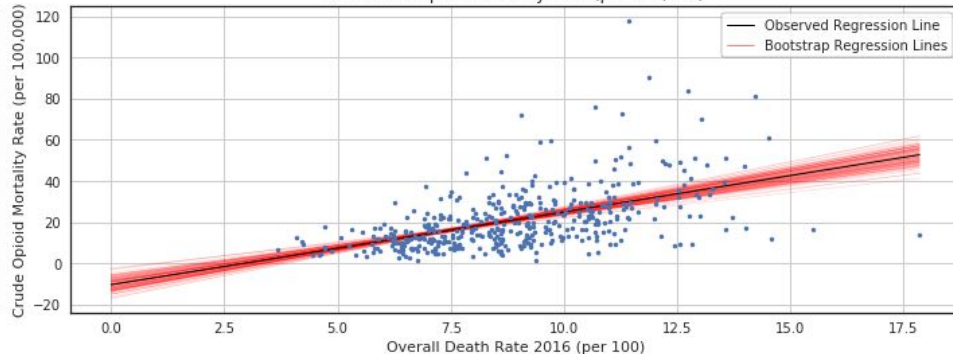
Observed Regression Line, Bootstrap Regression Lines  
and Scatter Plot of Overall Death Rate 2016 (per 100)  
and Opioid Prescription Rate (per 100)



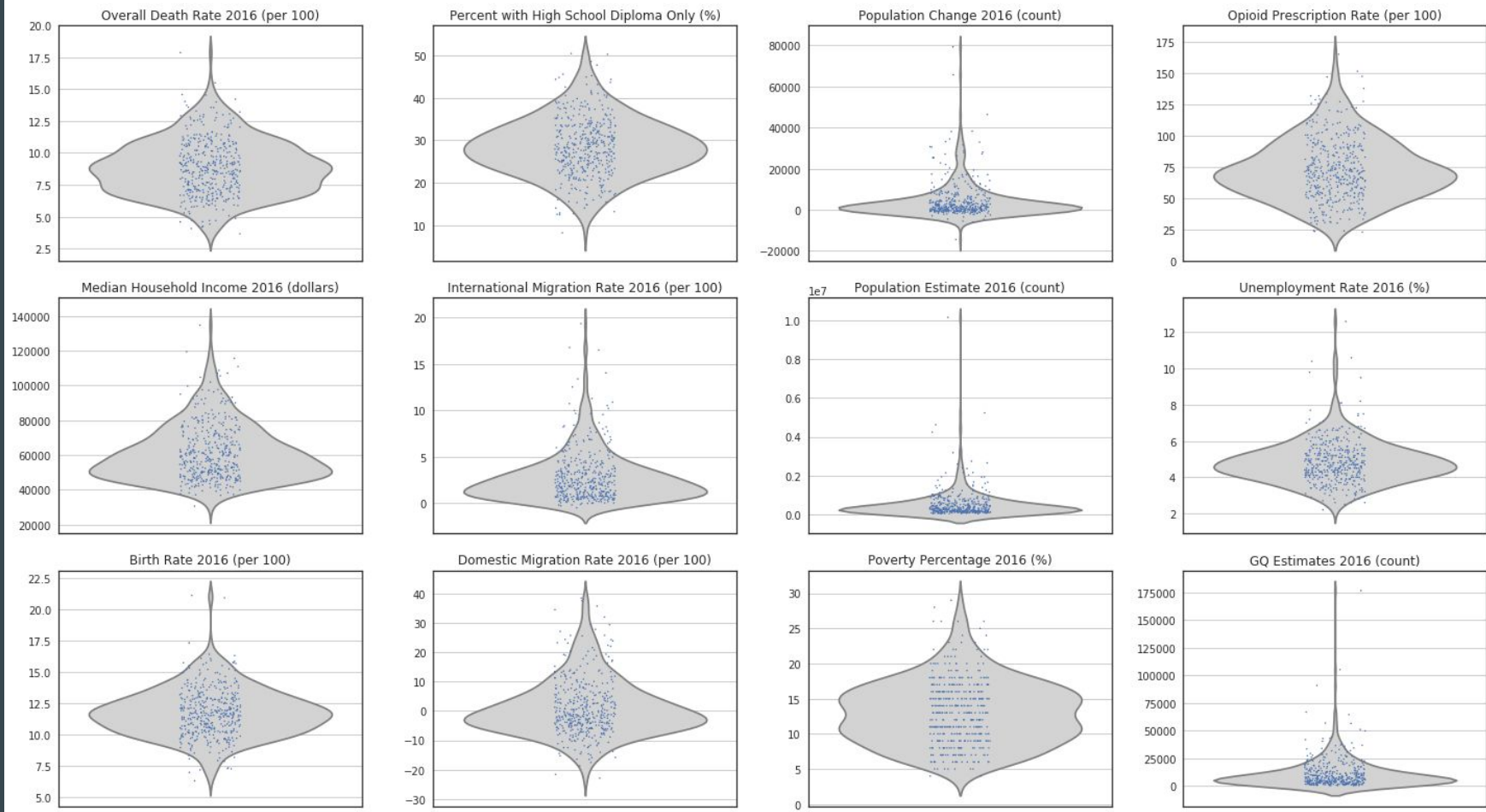
Bootstrap Sampling Distribution of the Slope  
of Regression Line for Overall Death Rate 2016 (per 100)  
and Crude Opioid Mortality Rate (per 100,000)



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