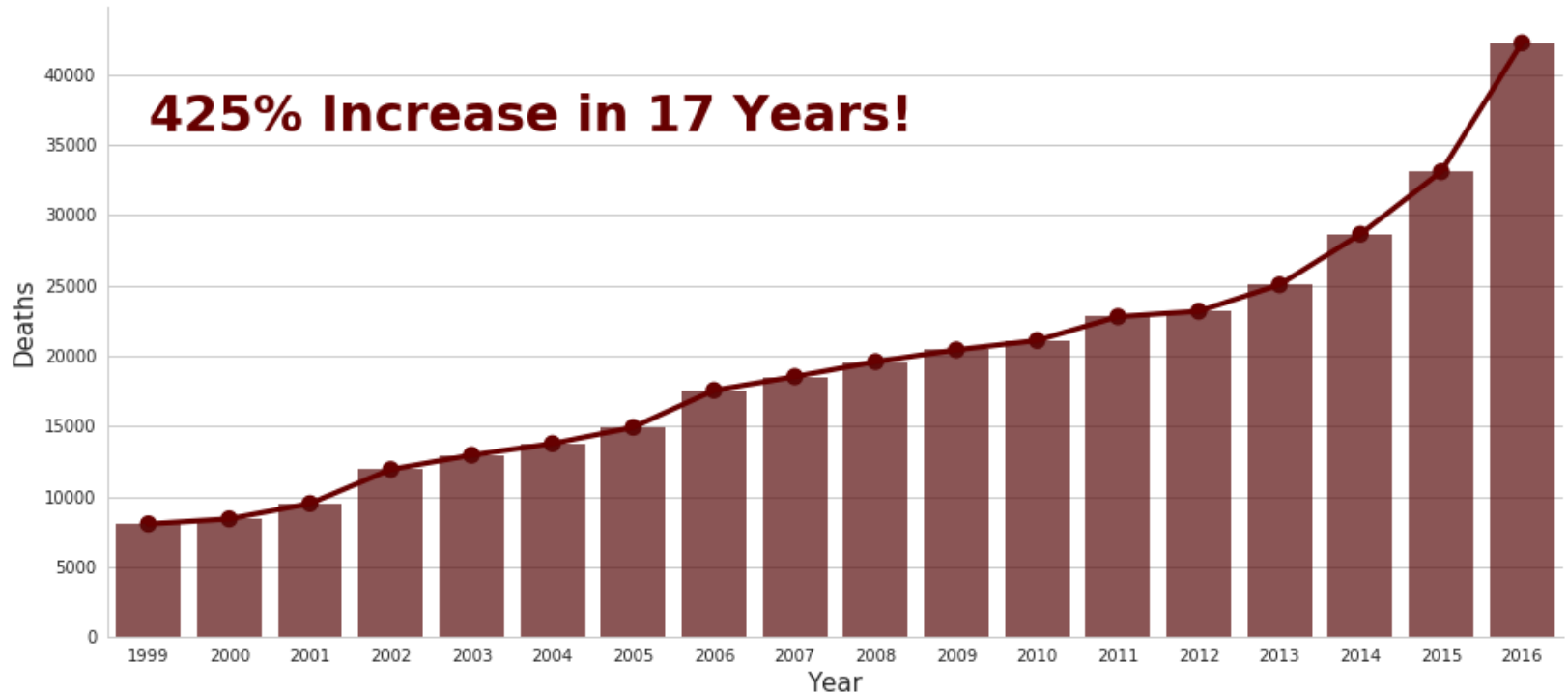


# Predicting the Mortality Rate Due to Opioid Addiction At the County Level

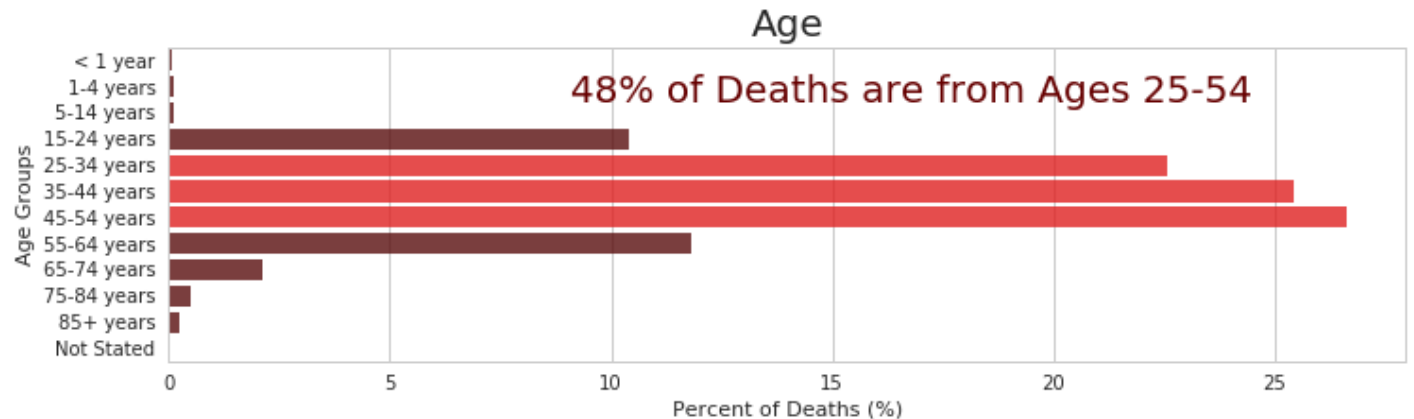
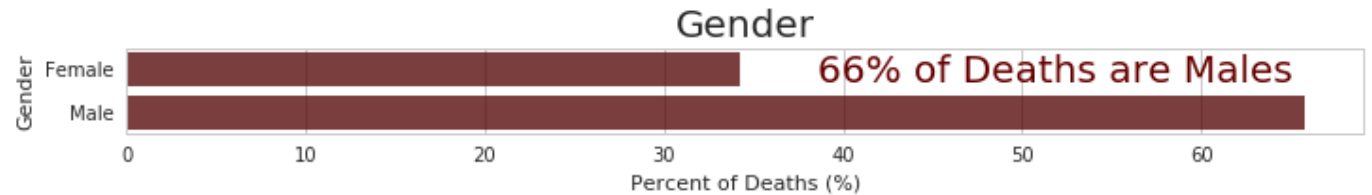
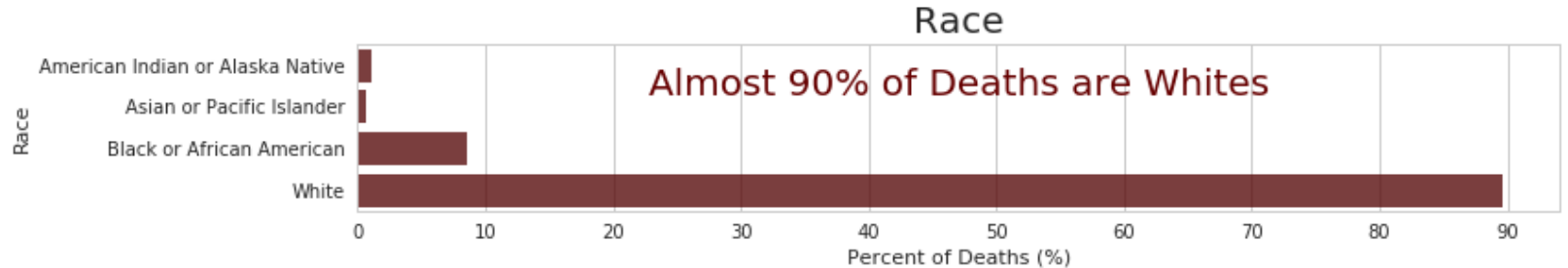
Daniel Lee

August 17, 2018

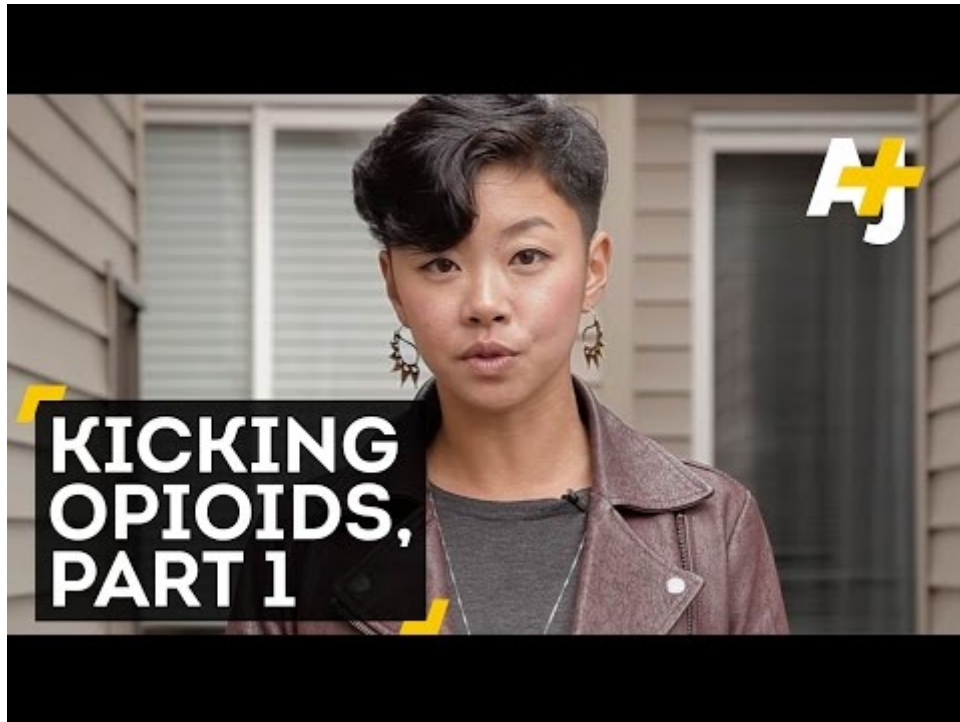
# Annual Cause of Death by Opioid Overdose



# Number of Deaths by Demographic Factors 1999 - 2016



## Living with an Opioid Addiction



(<https://www.youtube.com/watch?v=VpEQaa6jzUU>).

## Reading Between the Numbers - 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



# Opioids

- Diverse class of moderately strong painkillers

- Oxycodone



- Hydrocodone



- Fentanyl



# Problem

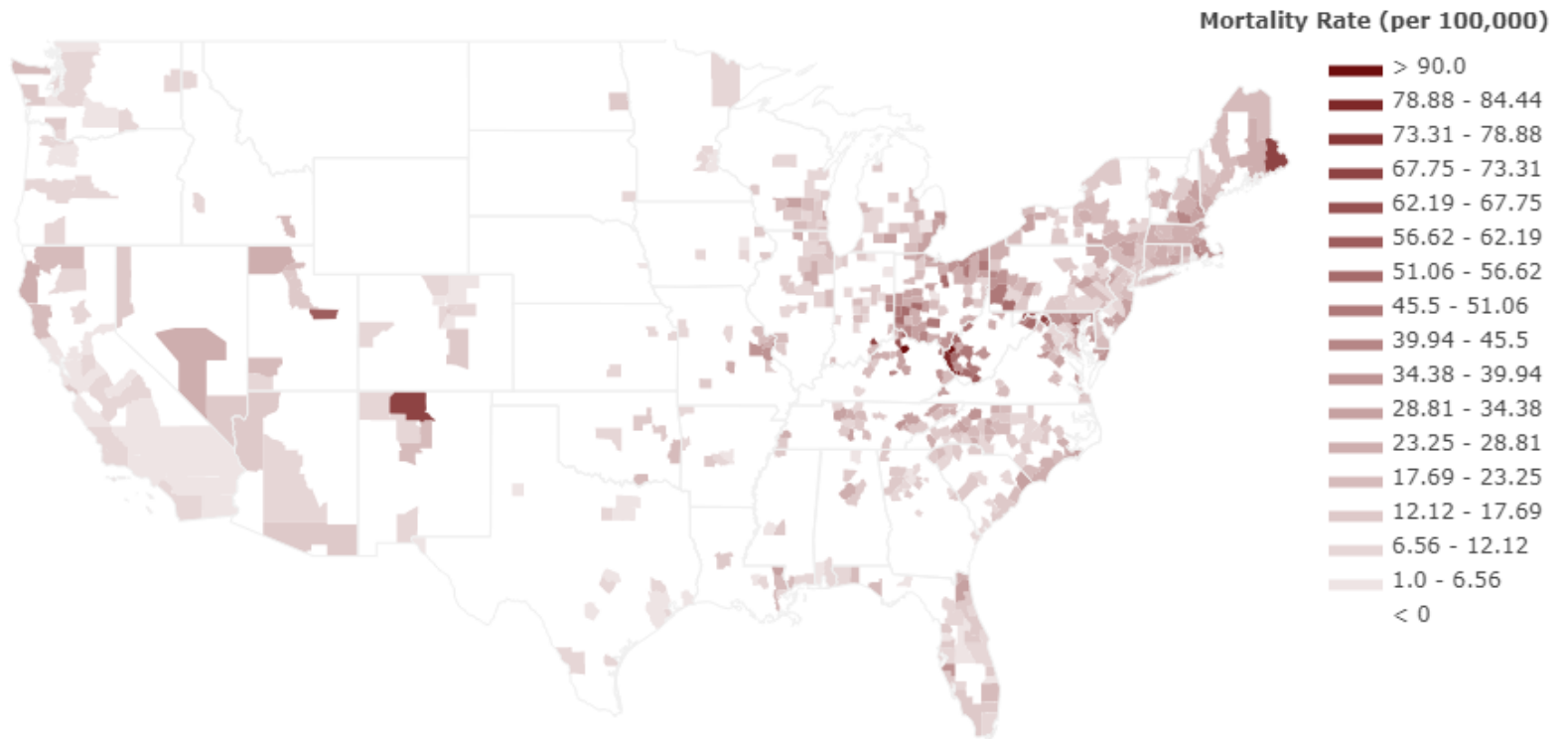
- Can we predict how bad the problem will be in a county?
  - Useful to help allocate resources
  - Learn more about causes of opioid overdose
  - Make biggest impact

# Problem

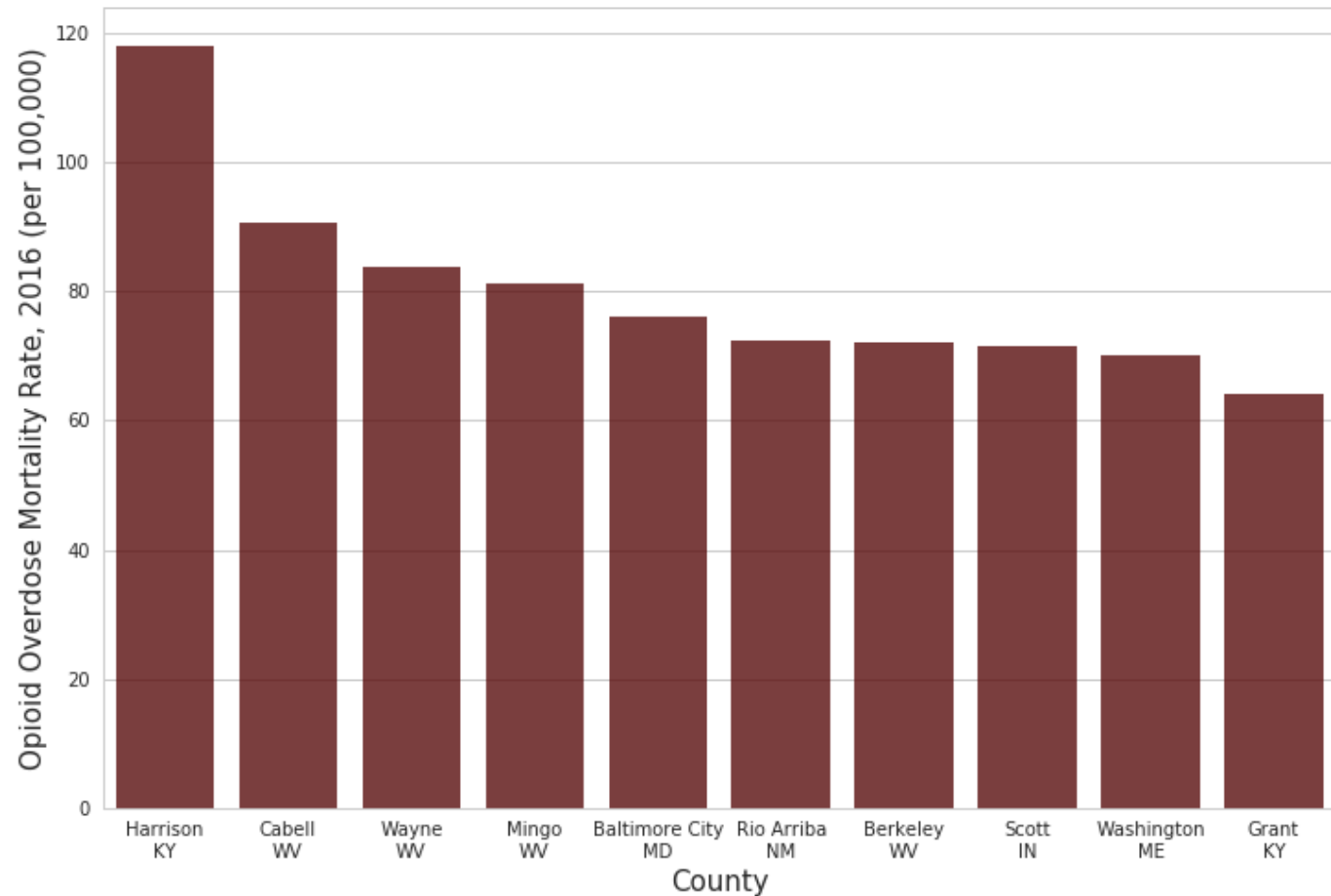
- Predict the county's mortality rate caused by drug overdose for 2016 given various independent variables
  - County's median household income
  - Population estimates
  - Unemployment
  - Poverty rate estimates
  - Educational attainment
  - Opioid prescription rate



# USA by Opioid Overdose Mortality Rate, 2016

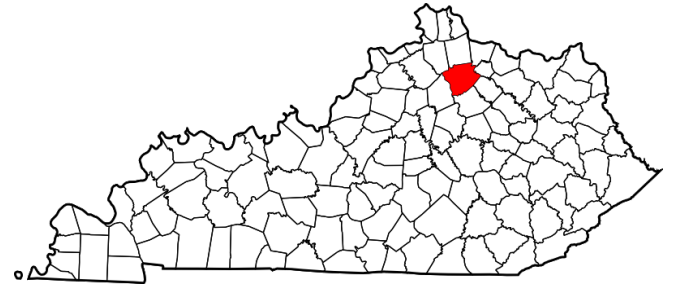


## Top Ten Counties with Highest Mortality Rate Caused by Opioid Overdose in 2016



## 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>  
(<https://www.cdc.gov/drugoverdose/maps/rxcounty2016.html>).
- Unemployment, median household income, educational attainment, poverty rate, and population:
  - <https://www.ers.usda.gov/data-products/county-level-data-sets/download-data/> (<https://www.ers.usda.gov/data-products/county-level-data-sets/download-data/>).
- Underlying Cause of Death
  - <https://wonder.cdc.gov/controller/saved/D77/D39F042>  
(<https://wonder.cdc.gov/controller/saved/D77/D39F042>).

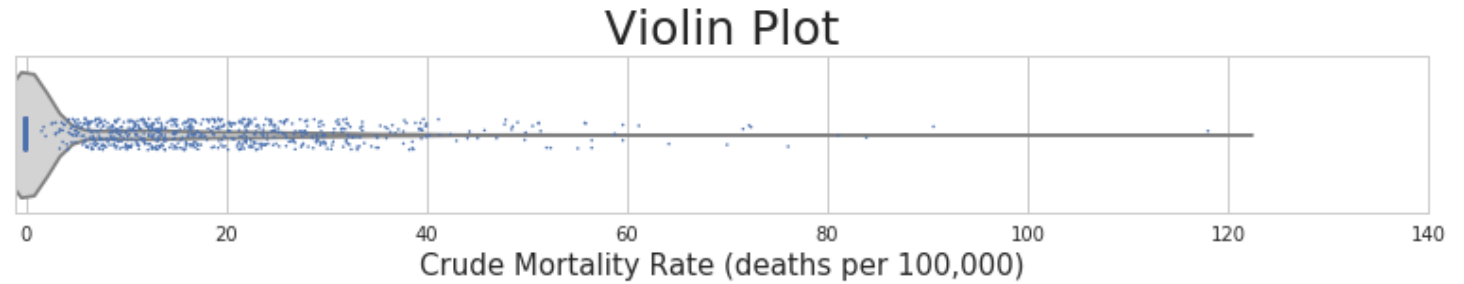
# Crude Opioid Mortality Rate

- 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

# Crude Opioid Mortality Rate

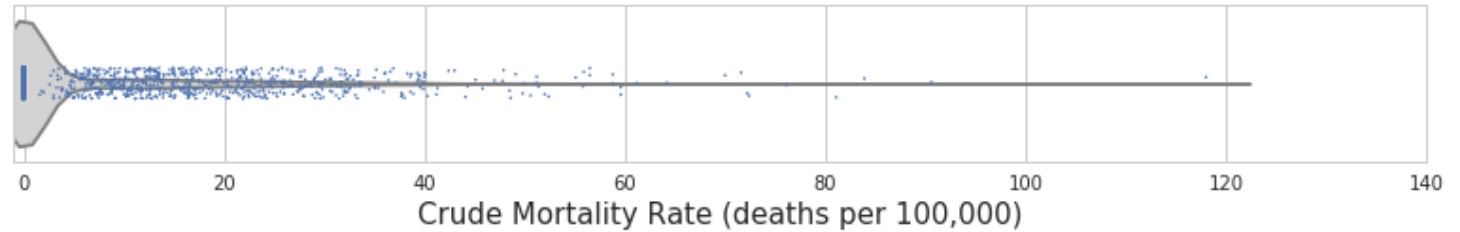
- The specific drugs included in the death rates are the following:
  - Opium
  - Heroin
  - Other opioids
  - Methadone
  - Other synthetic narcotics
  - Other unspecified narcotics

# Distribution of County Level Opioid Overdose Mortality Rate

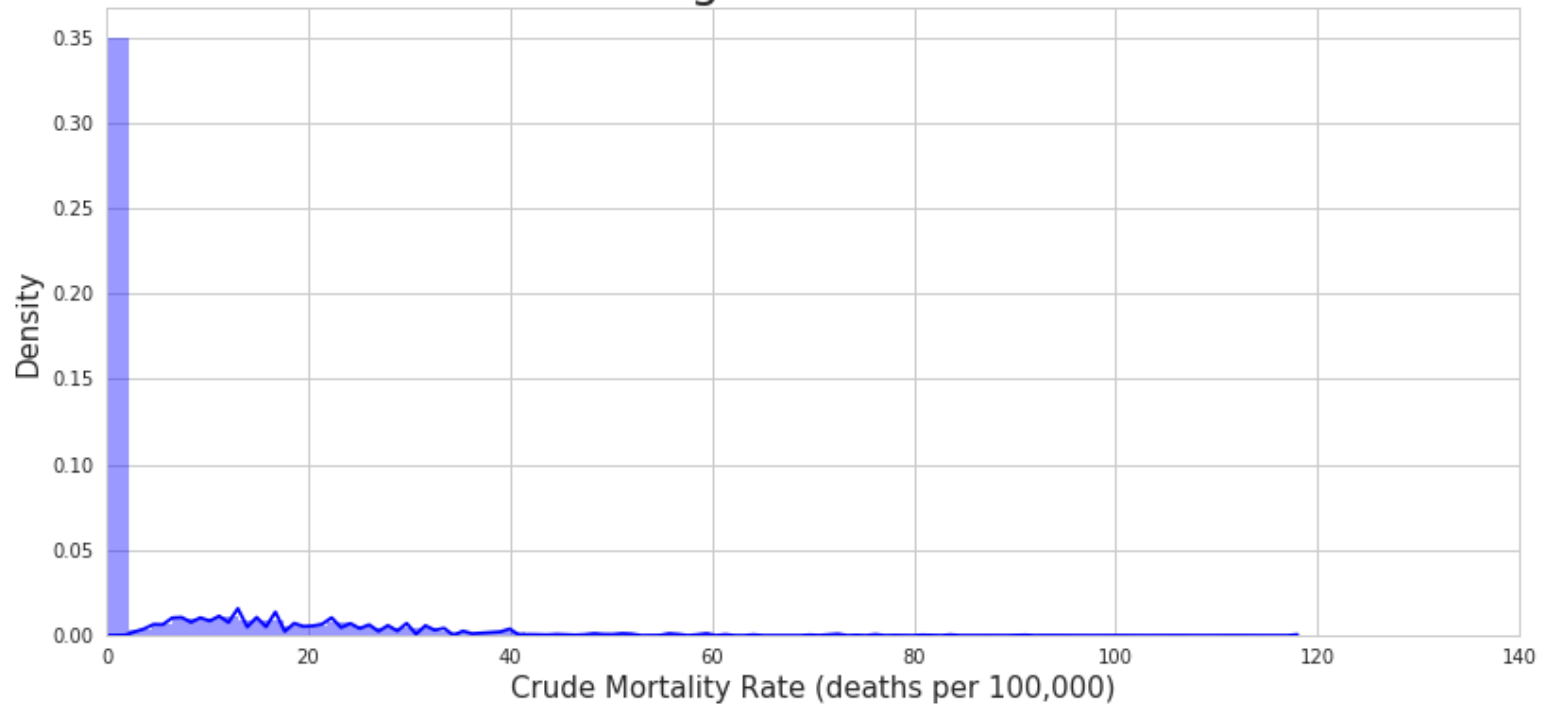


# Distribution of County Level Opioid Overdose Mortality Rate

Violin Plot



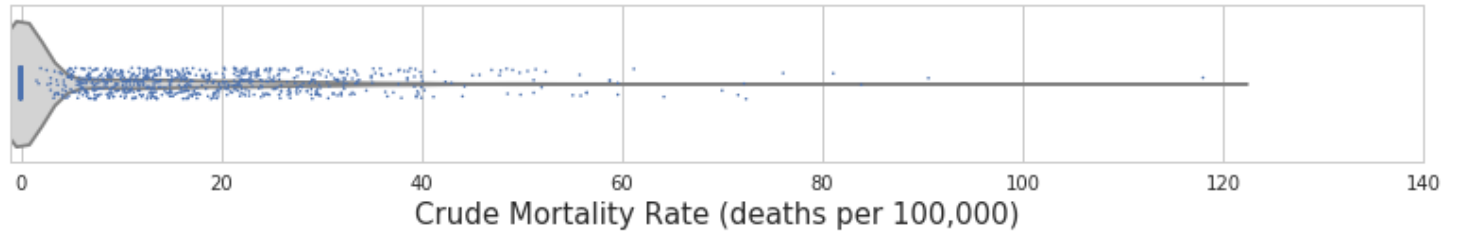
Histogram



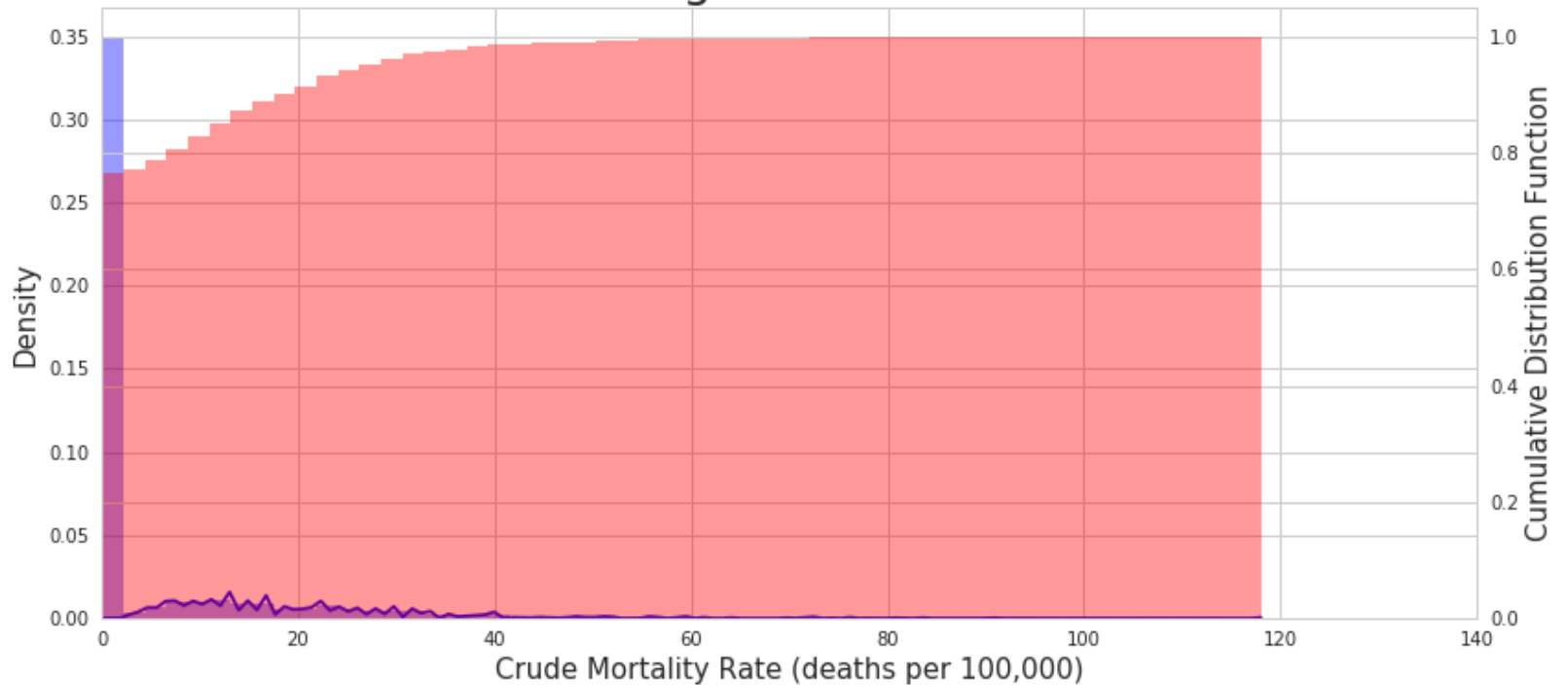


# Distribution of County Level Opioid Overdose Mortality Rate

## Violin Plot

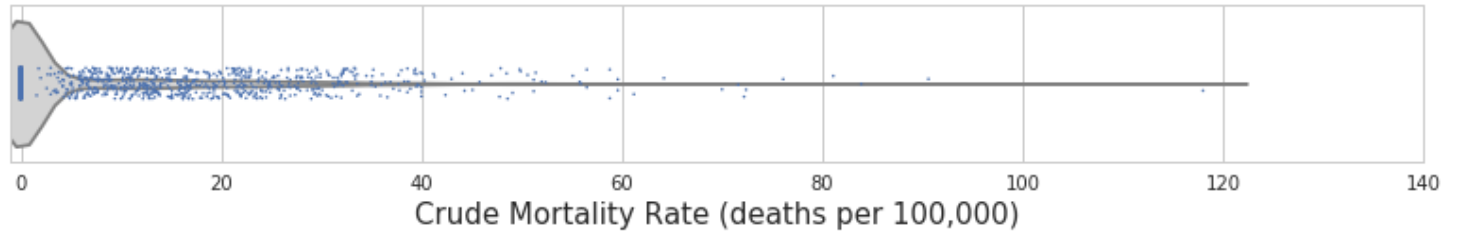


## Histogram and CDF

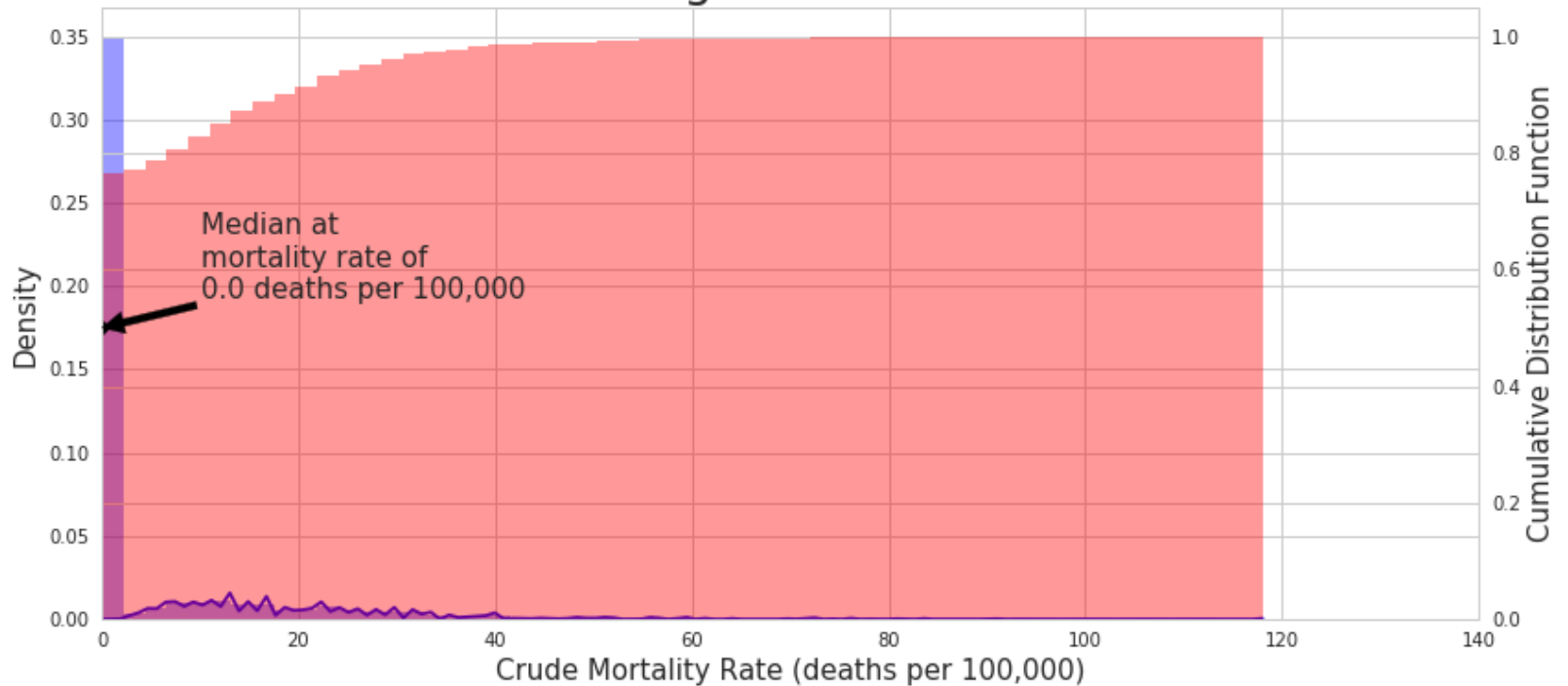


# Distribution of County Level Opioid Overdose Mortality Rate

## Violin Plot

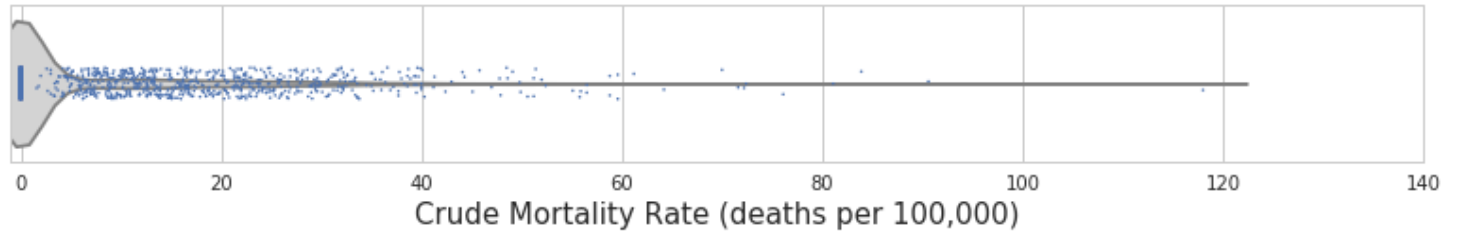


## Histogram and CDF

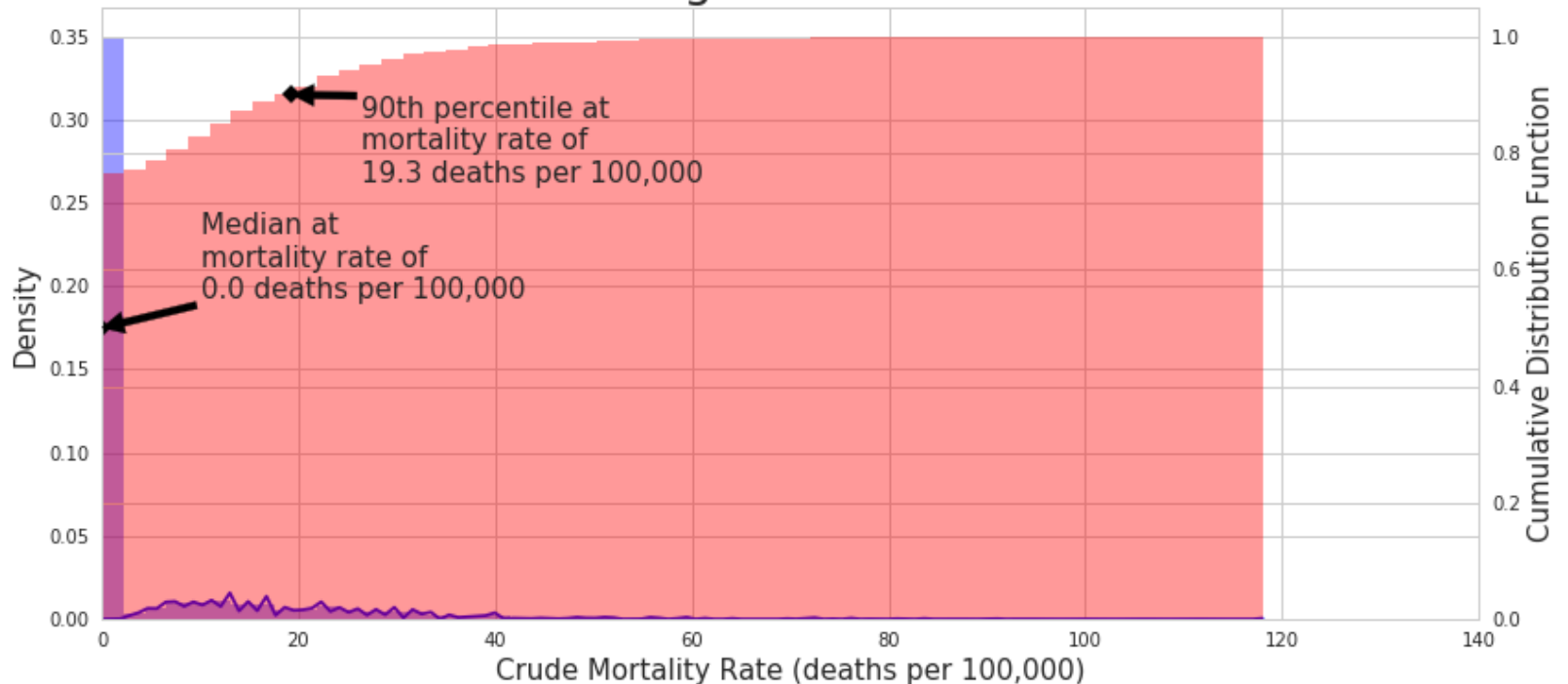


# Distribution of County Level Opioid Overdose Mortality Rate

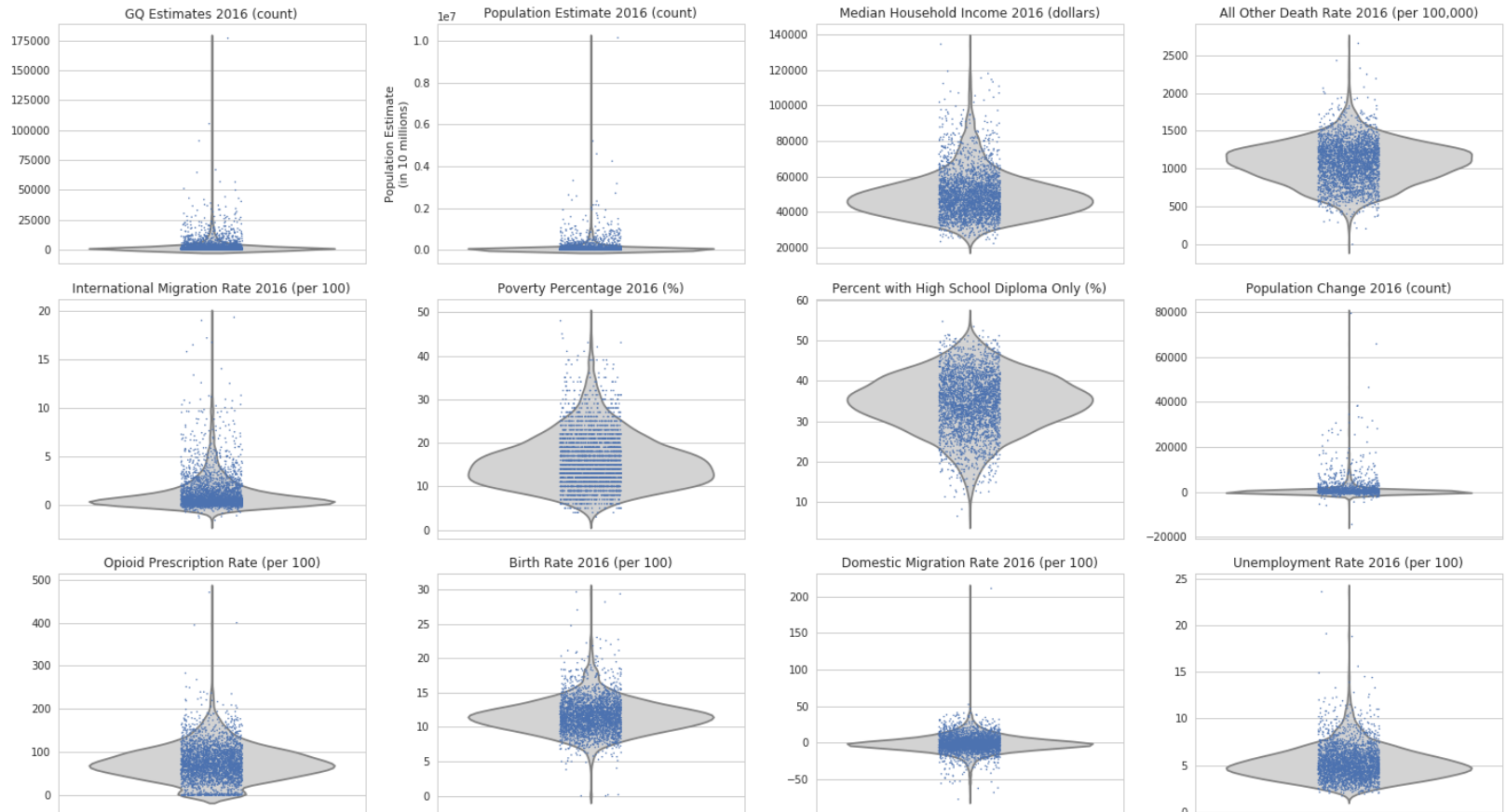
## Violin Plot



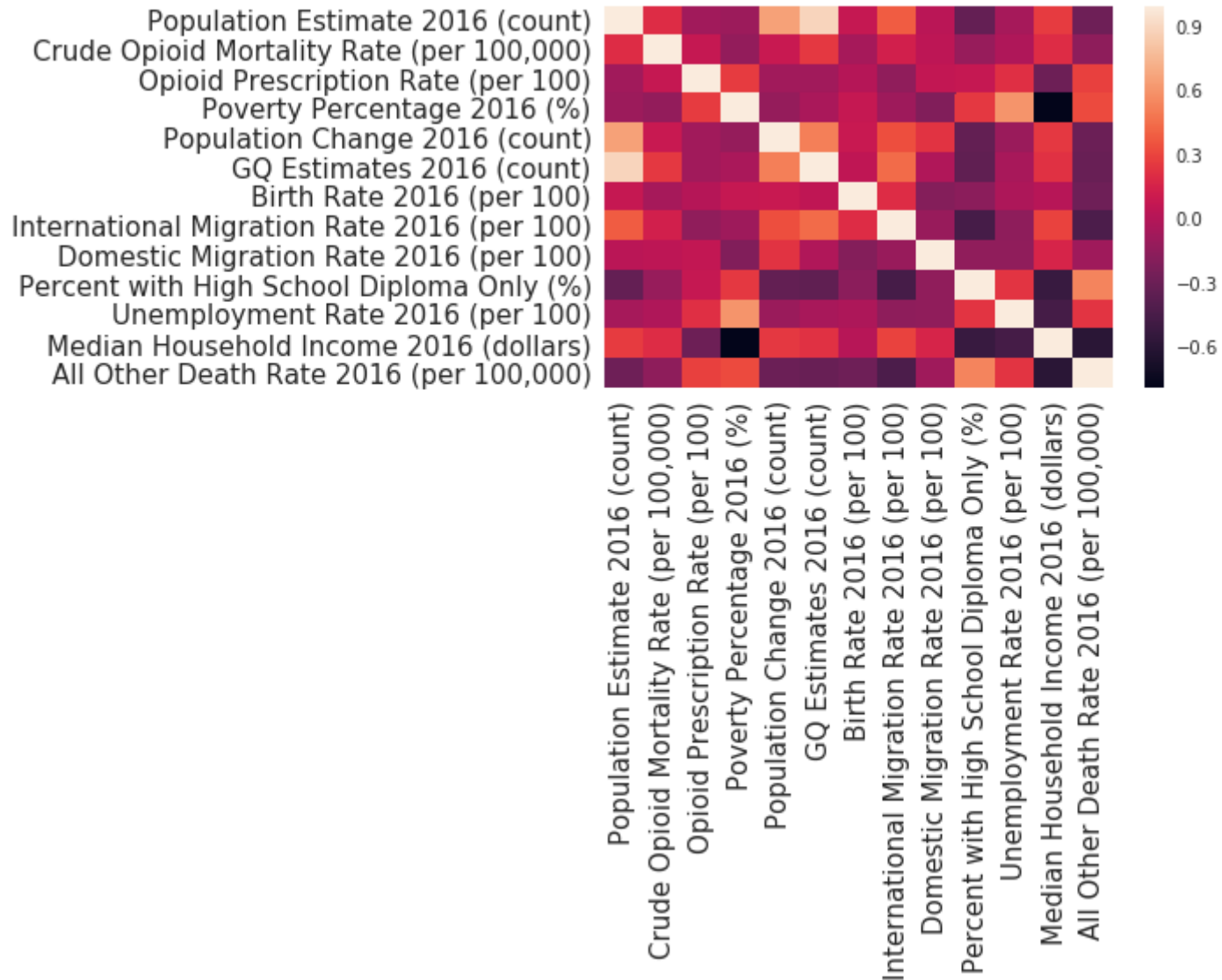
## Histogram and CDF



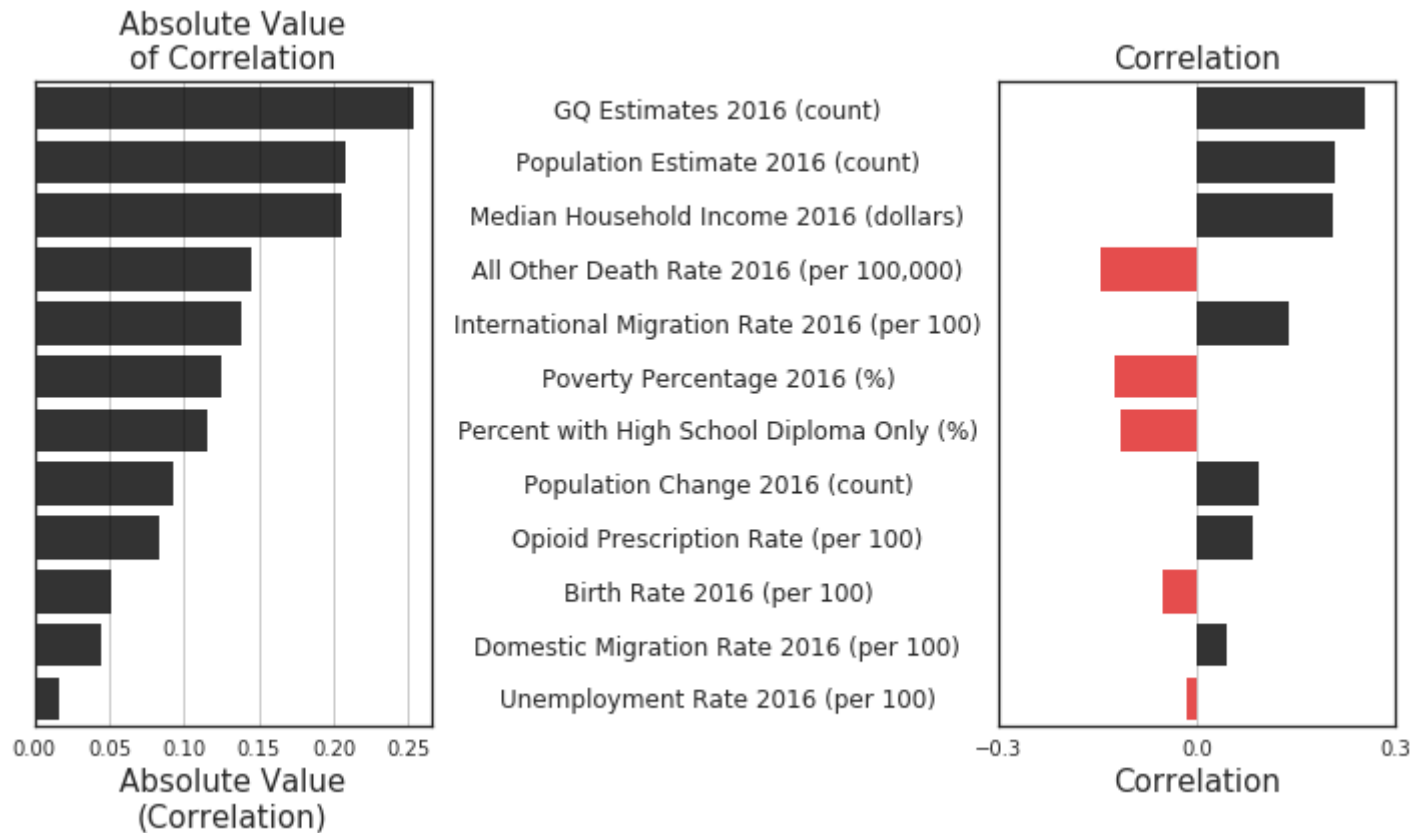
# Violin Plots of All Variables Except Crude Mortality Rate



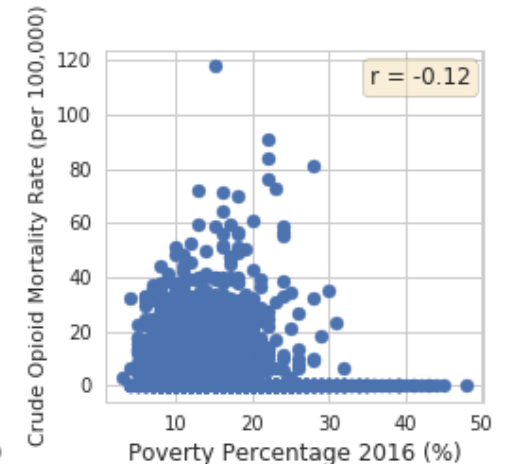
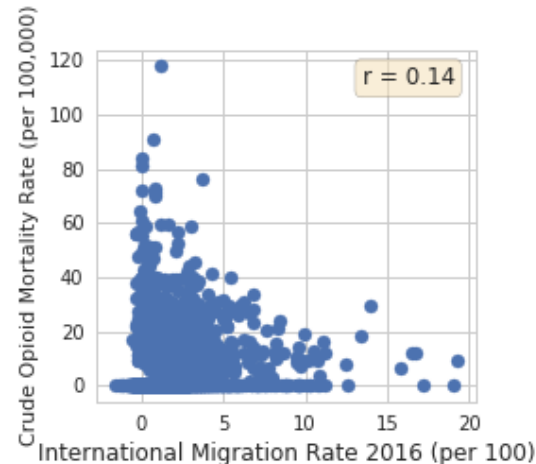
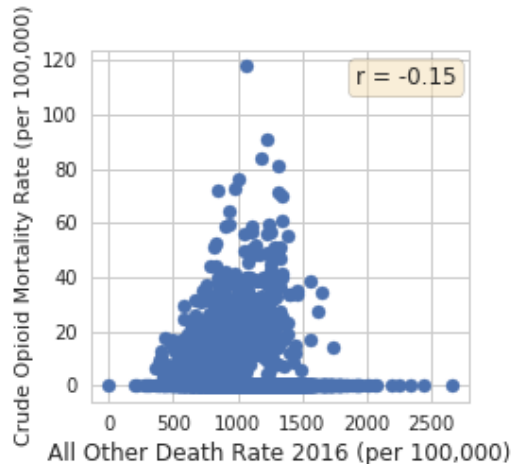
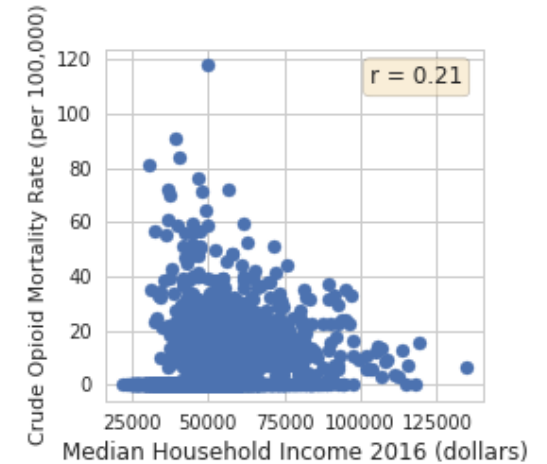
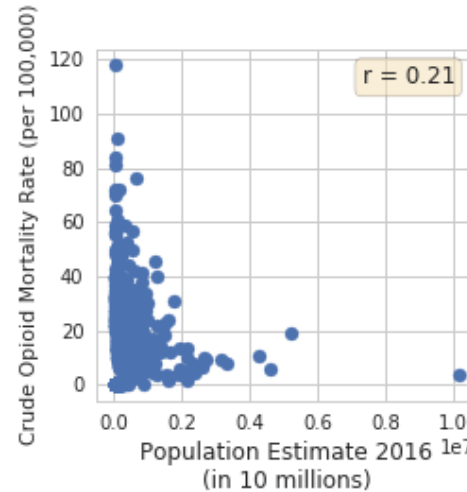
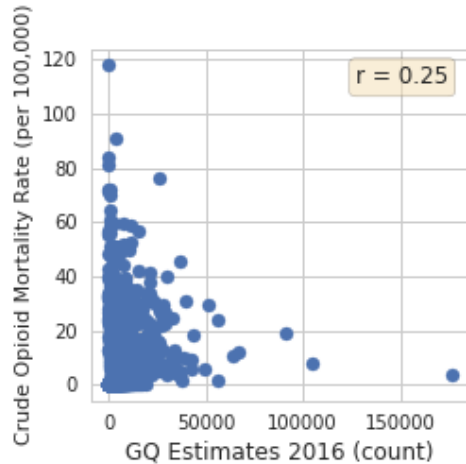
## Correlation Heat Map of All the Variables



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

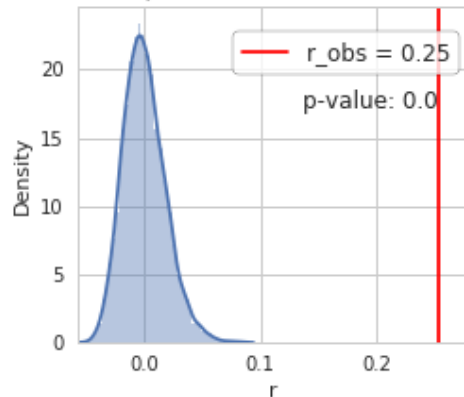


# Scatter Plots of Crude Opioid Mortality Rate and Other Variables

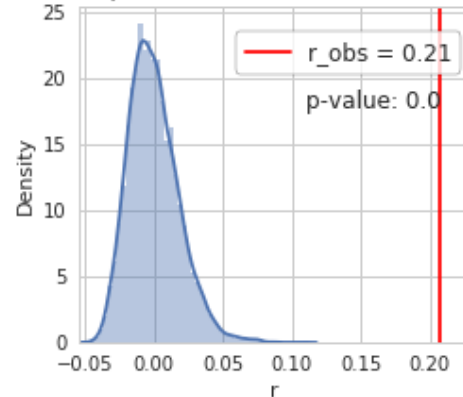


## Hypothesis Test of Correlation By Permuting Samples - Distribution of Correlation Values

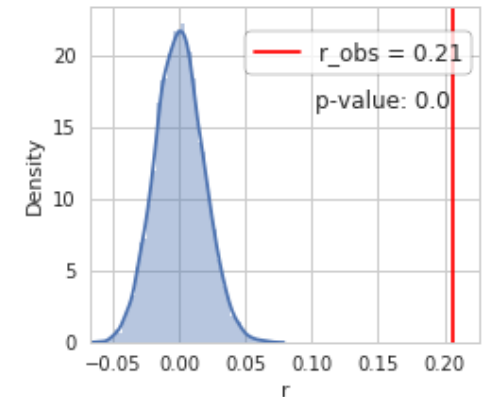
Opioid Mortality Rate (per 100,000) and  
GQ Estimates 2016 (count)



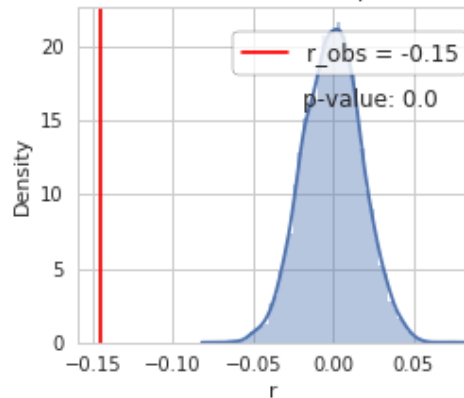
Opioid Mortality Rate (per 100,000) and  
Population Estimate 2016 (count)



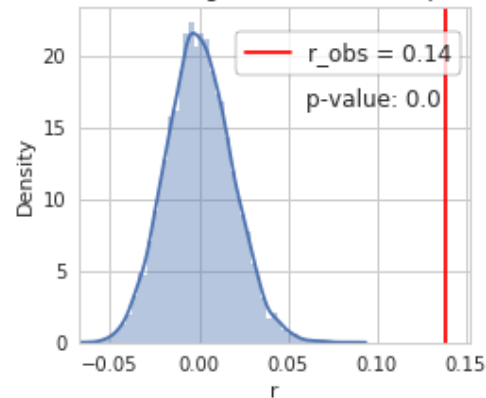
Opioid Mortality Rate (per 100,000) and  
Median Household Income 2016 (dollars)



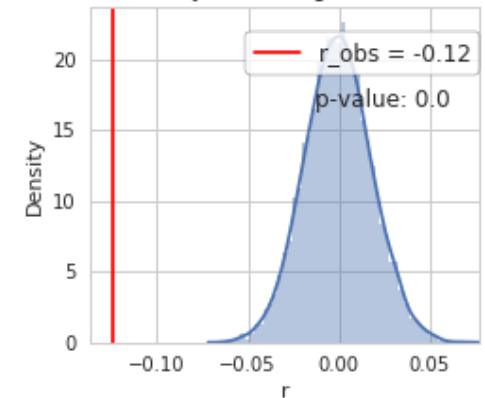
Opioid Mortality Rate (per 100,000) and  
All Other Death Rate 2016 (per 100,000)



Opioid Mortality Rate (per 100,000) and  
International Migration Rate 2016 (per 100)

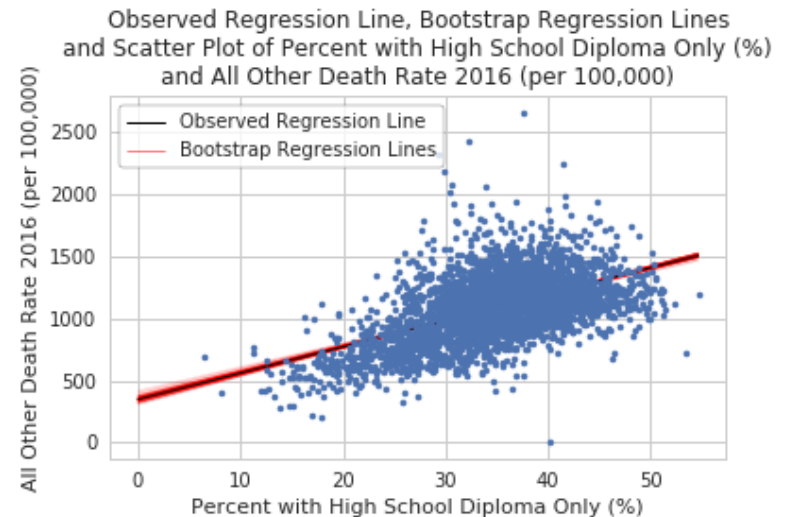
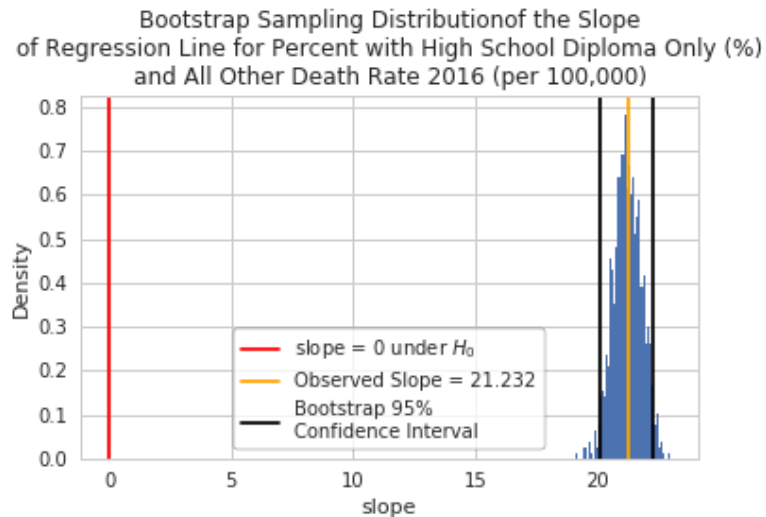
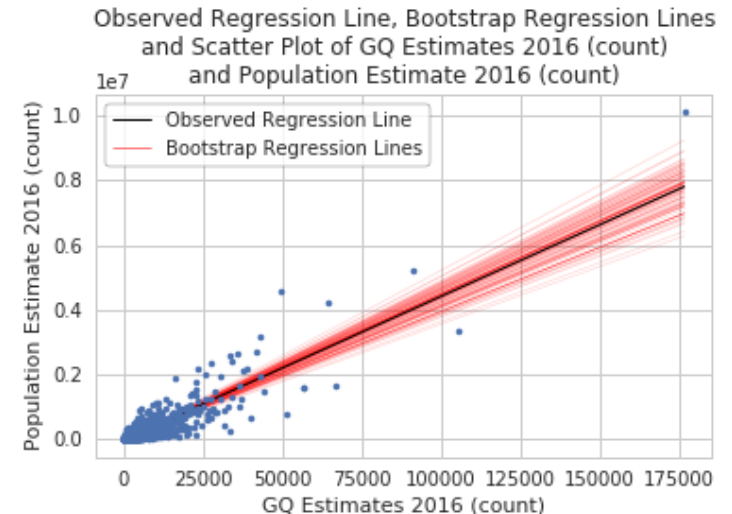
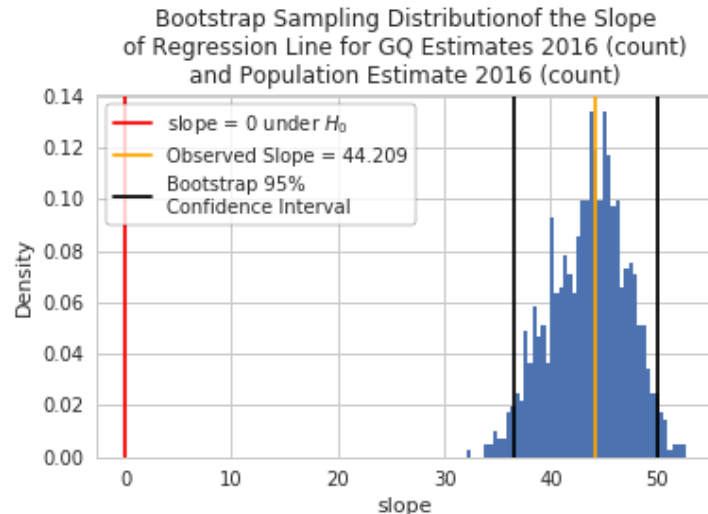


Opioid Mortality Rate (per 100,000) and  
Poverty Percentage 2016 (%)





# Linear Regression and Confidence Interval Using Pairs Bootstrap



## Conclusion From Exploratory Data Analysis

- Counties with higher opioid addiction mortality rates have
  - Higher GQ estimates
  - Higher population estimates
  - Higher median household income

## Conclusion From Exploratory Data Analysis

- Further research
  - Why do counties that have higher population living in group quarters have higher opioid overdose mortality rates?
    - Possibly consider looking into specific group quarters estimates by county