

California Carbon Emissions and Impact on Wildfires

Introduction:

California has recently been on the news for its constant and destructive wildfires. California is the largest state in the United States based on its population. California is also experiencing a steady increase in population. So, the question must be asked, “Has the increase in population of California effected the carbon emission of the state? And if this is assumed to be true how does this impact the frequency and destruction of wildfires?” The purpose of this project is to delve into the mystery of California wildfires and understand their destructive behaviors within a 16-year time period.

Background:

The datasets that are under analysis are provided by the California Air Resources Board, National Interagency Fire Center, and the California Census. These data sets are ranged from the year 2002 through 2017. The first dataset is California’s Carbon Emissions, specifically CO₂. The data provided by the website has the CO₂ producers and categorizes them by: Transportation, Industrial, Electric Power, Agriculture, Commercial and Residential, Biogenic, and Excluded. The categories are summed up by year for total CO₂ emissions in the state of California. The second data set that is being analyzed is a set of data with total number of reported wildfires in the state of California and the number of recorded acres burned in those wildfires. The third and final dataset is the population of California from 2002 through 2017.

Taking a closer look at the specific information these individual dataset’s categories are giving is important to understanding the overall goal of this project. To begin, the ‘Transportation’ category under the ‘Emission’ dataset is providing an overall estimate of the

amount of CO₂ being produced by passenger vehicles, heavy duty trucks, ships & commercial boats, aviation, rail, off road, and unspecified. The 'Industrial' category pertains to: refineries, oil & gas: production & processing, and cogeneration heat output. The 'Electrical Power' category is broken down into: in-state generation and imported electricity. The 'Commercial and Residential' category contains: residential fuel use and commercial fuel use. 'Agriculture' contains: crop growing & harvesting and general fuel use. 'Biogenic' represents the CO₂ produced by living organisms. 'Excluded' is representing the emissions that do not fit in any of the other categories.

The 'Wildfires' dataset is containing the number of fires reported in the state of California and the number of acres destroyed. These are considered as the frequency and destructivity of wildfires in the state. The website that provides the data records these numbers for all the states within the United States of America. The reported fires are formal to the state of California and the wildfire is reported from organizations, individuals, radars, and official government departments. The acres burned are a fixed number and summed for all fires that happened within the year.

The 'Population' dataset is provided by the Census of California and is recorded in the millions. It is important to note that the population of California is higher than any other state and has been exponentially growing for a long period of time.

Methods:

The methods in the code are very simple and straight forward. The code is written in Rstudio and the datasets are stored in excel files (.xlsx). The excel files are important into Rstudio through simple code and the datasets are broken down into variables. The next step in

the process is to graph all data with respect to time. This is to get a general understanding of the trends of the data and see if there can be any pattern that is visual at first glance. Following, there will be 2-Dimensional matrices formed by: population and fires, population and acres, population, and emissions, fires and emissions, acres and emissions. Creating these matrices is to then get the correlation of these variables. The variables correlations will be analyzed for their closeness to -1 and 0 or 0 and 1. The correlation will be used to then create predictive models for fires in the state of California for their destructivity and frequency. There will also be predictive models for the emissions and population of California.

Trends and Predictions:

The graphs show for some of the variables of the 'Emissions' datasets that there will be no clear trend of the variable. However, based on some of the raw data, that other variables will have a very clear trend. The population is predicted to act as an exponential growth for the entire history of California but in this range of data it will be linear. The wildfires I believe are more random and so I think there will be a hidden trend through further analysis.

Some of the variables under consideration and specifically those being used to calculate correlations will have a clear correlation. But since there is a sense of randomness and unpredictability in wildfires there will be no clear correlation.

Analysis:

The initial prediction that was made, although there is a sense of randomness to wildfires, is that the data could show some hidden relationship. However, upon analysis it was shown that there was no clear relationship between the frequency of wildfire and population growth,

frequency of wildfires and total carbon emissions, total acres destroyed and population growth, and total acres destroyed and total carbon emissions. The only trend that the data shows is between population growth and total carbon emissions.

Looking further at the graphs titled “Total fires and Population”, “Acres Destroyed and Population”, “Total Fires and Total Carbon Emissions”, and “Acres Destroyed and Total Carbon Emissions” it can be seen with a glance that there is no clear trend between the two data sets. This initial thought was proven to be true after calculating the correlations. For “Total fires and Population” the variables have a correlation value of 0.118. This value is closer to 0 than it is to 1 so it can then be assumed that there is no relationship between Total Fires and Population. Secondly, the variables “Acres Destroyed and Population” have a correlation value of 0.205. Once again, this value is close to 0 and can then be determined that the variables do not have a relationship. Next, “Total Fires and Total Carbon Emissions” produced a correlation of -0.202 showing there is no relationship. Lastly, “Acres Destroyed and Total Carbon Emissions” has a correlation of 0.280 also showing no direct relationship. The only instance that is seen of a strong relationship shown by the variable’s correlation is “Population and Total Carbon Emissions”. The graph titled “Population and Total Carbon Emissions” clearly demonstrates that there is a strong linear relationship for the variables in this set time range. The correlation produced by “Population and Total Carbon Emissions” is -0.916. The value is close to 1 showing a strong negative linear correlation.

Discussion:

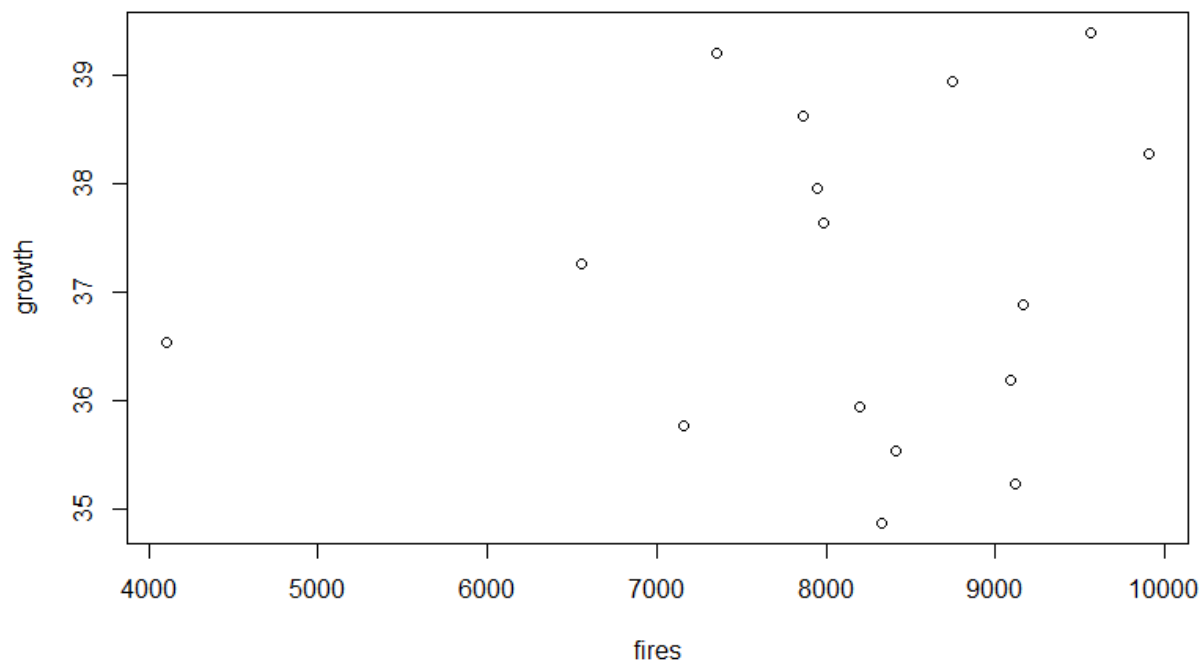
There could be many variables outside of Carbon Emissions and Population playing a role in the frequency and destructivity of wildfires. Some of these variables could be response time to put out the fire, ambient temperature, location, legislation, and the randomness of natural

wildfires. These could all be playing a part in the overall frequency and the destructivity of wildfires California. However, it is logical to see a correlation between Population and Carbon Emissions. The reason it is logical is that if there is a large amount of people moving into California, that means that there will be a large increase in CO₂ being produced. However, in the raw data it is seen that as the population increases there is a decrease in CO₂ being produced by the state. This shows that there are more people producing less CO₂ than ever before in California's history.

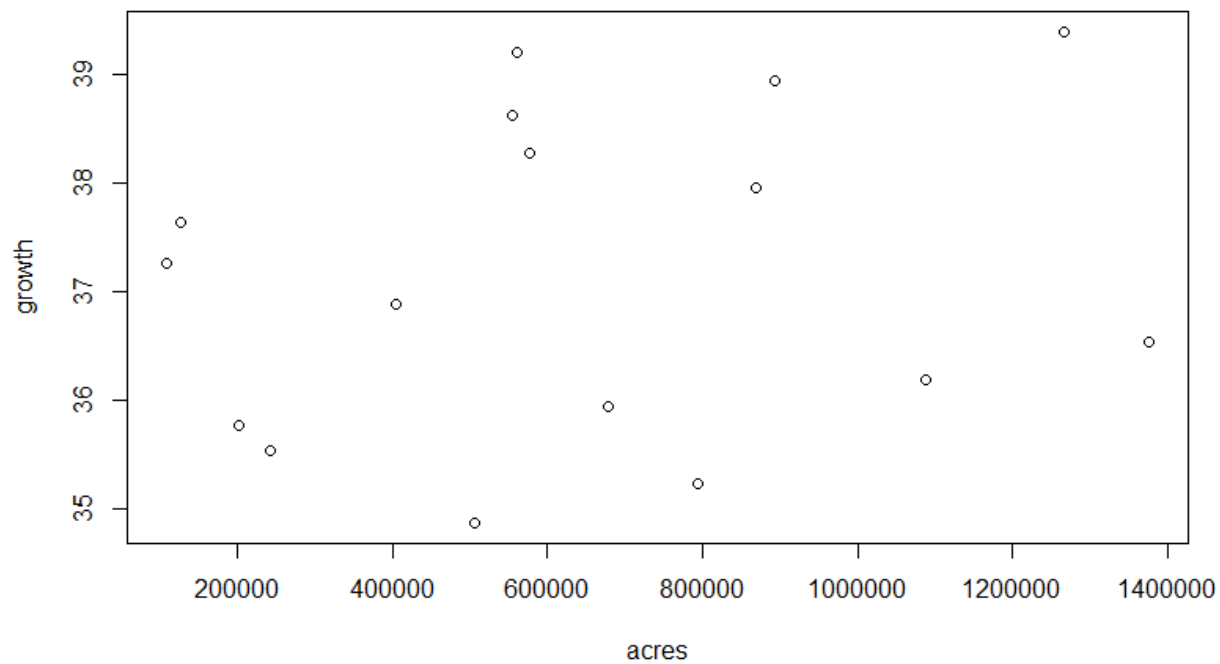
Conclusion:

In conclusion, the population of California has been shown to have a direct impact on the Total Carbon Emission of the state. As the correlation for the variables shows that there is a clear negative linear correlation between Population and Total Carbon Emissions for the state of California. And since this was discovered the impact of population and carbon emissions on frequency and destructivity of wildfires was investigated and found that there is no direct relationship between these variables. So, over the 16-year period it was found that California's carbon emissions have decreased by approximately 50 percent. The unpredictability and randomness of wildfires and several other variables might have an unseen impact on the destruction of wildfires and their frequency.

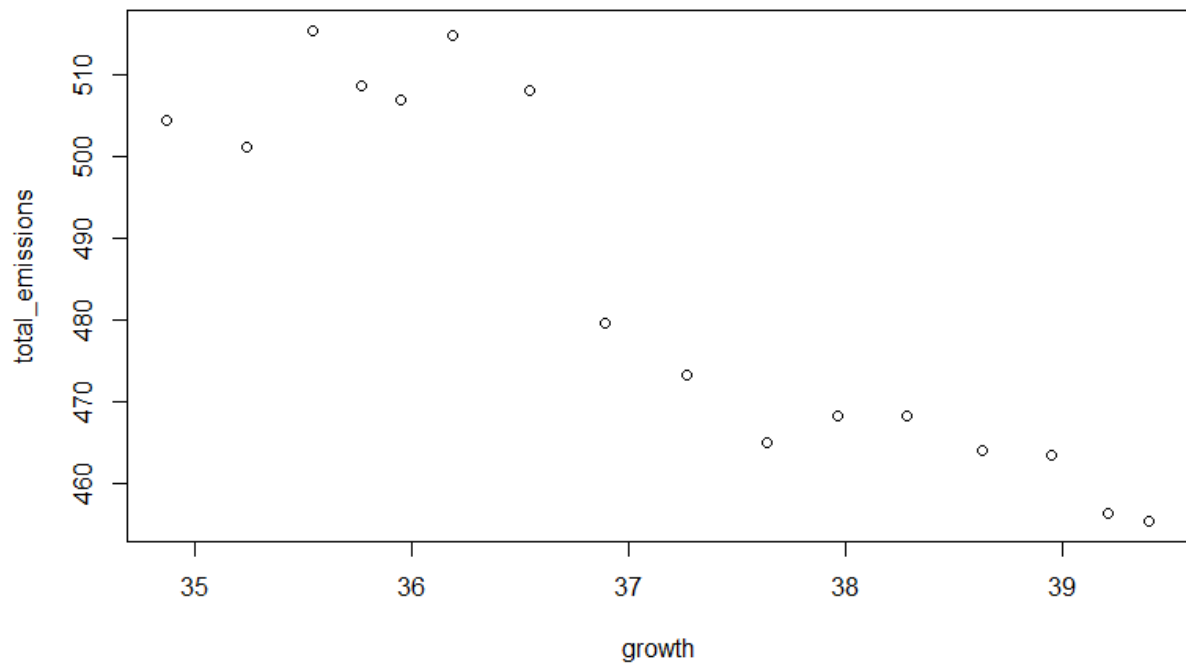
Total fires and Population



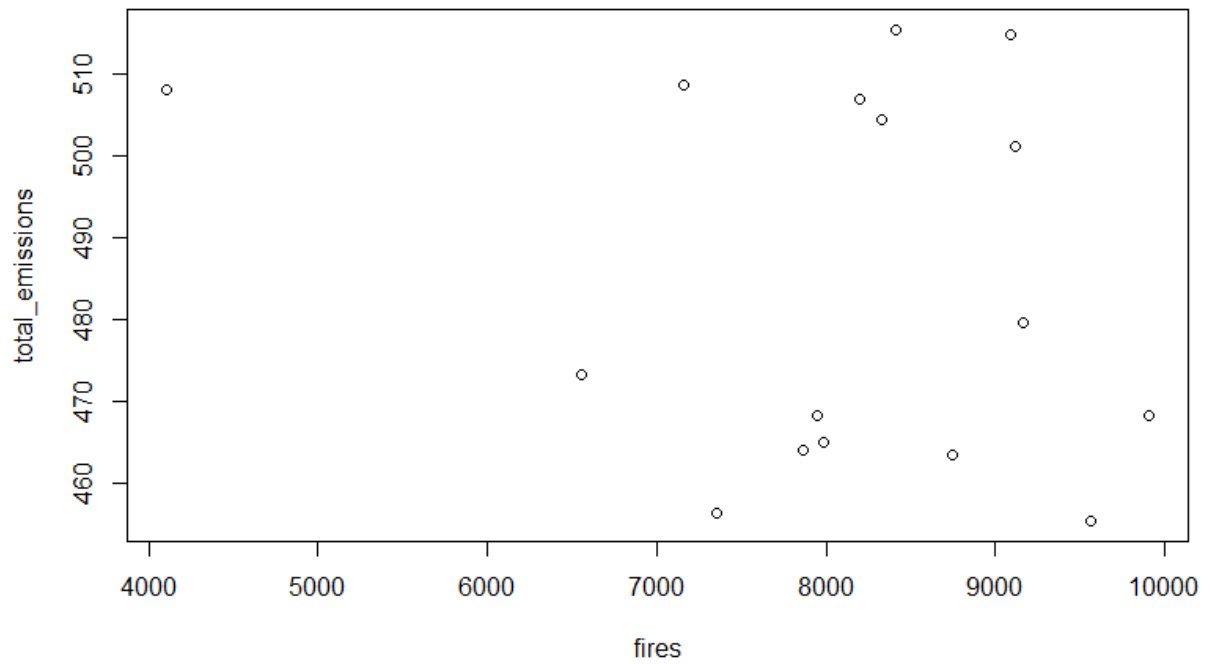
Acres Destroyed and Population



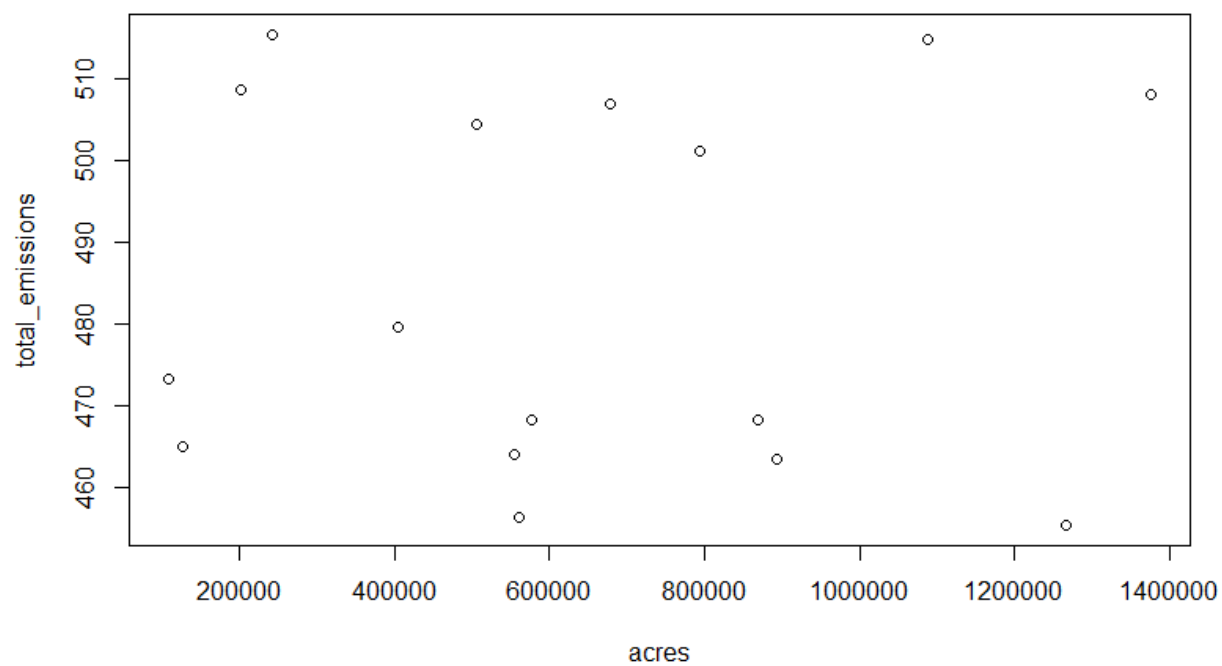
Population and Total Carbon Emissions



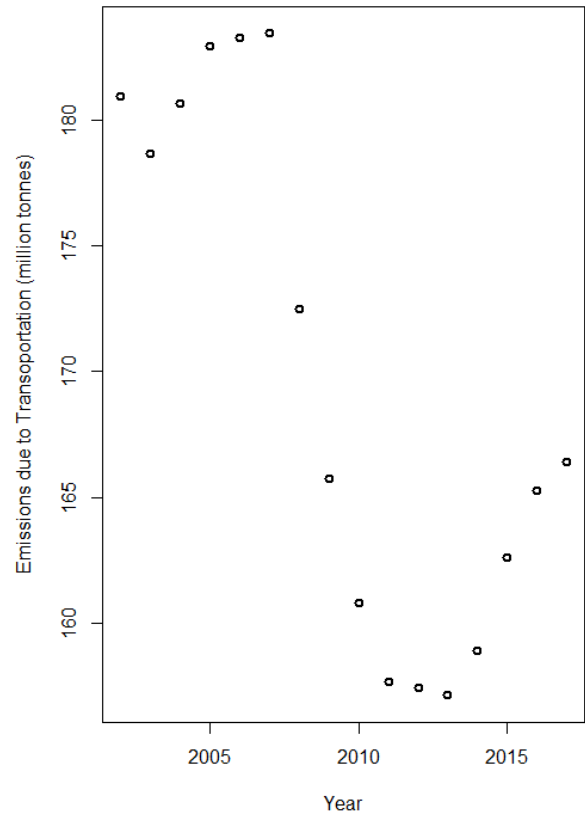
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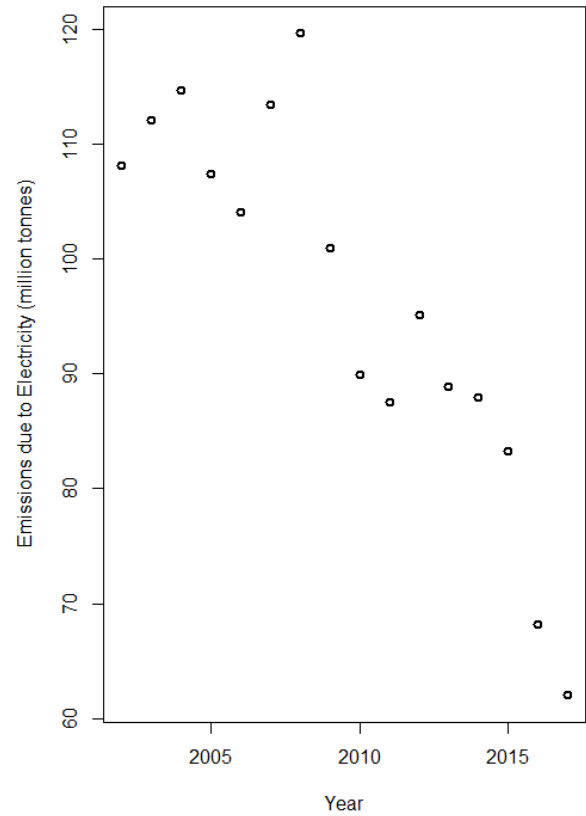
Acres Destroyed and Total Carbon Emissions



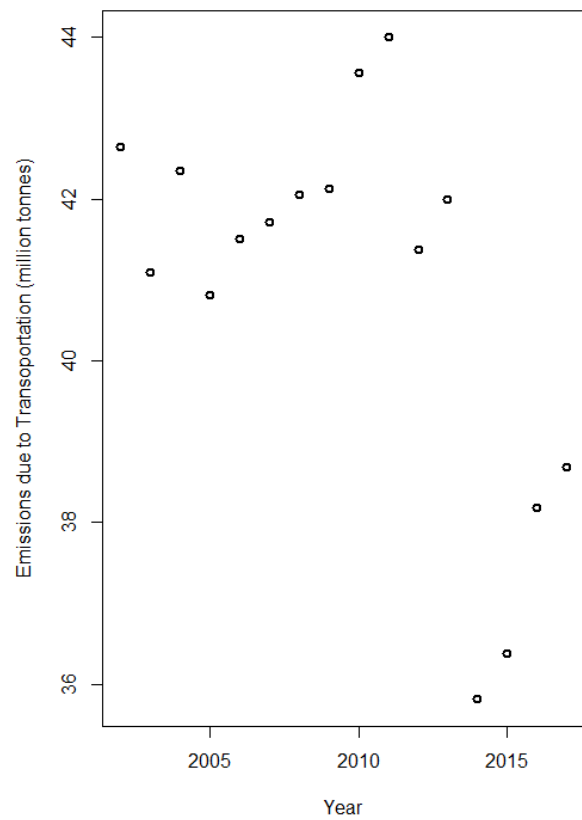
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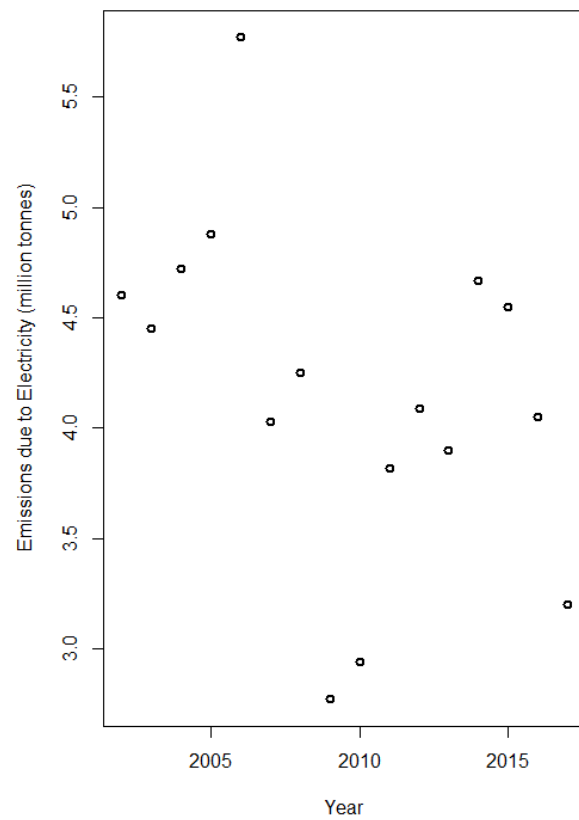
California Electricity Emissions 2002-2017



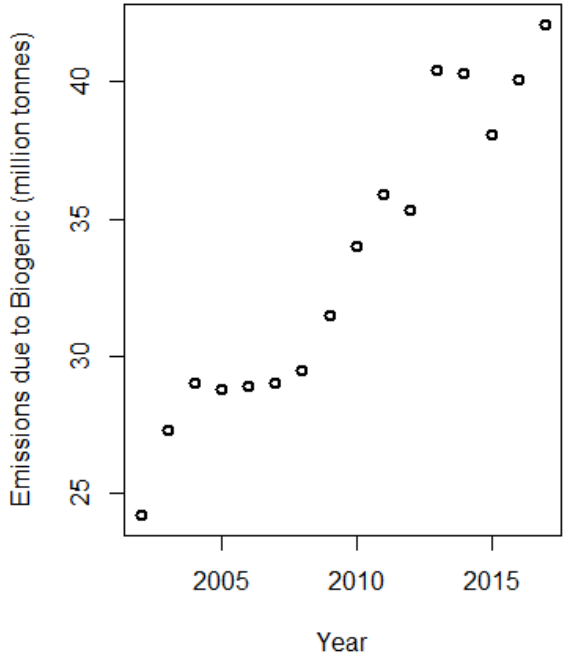
California Commercial and Residential Emissions 2002-2



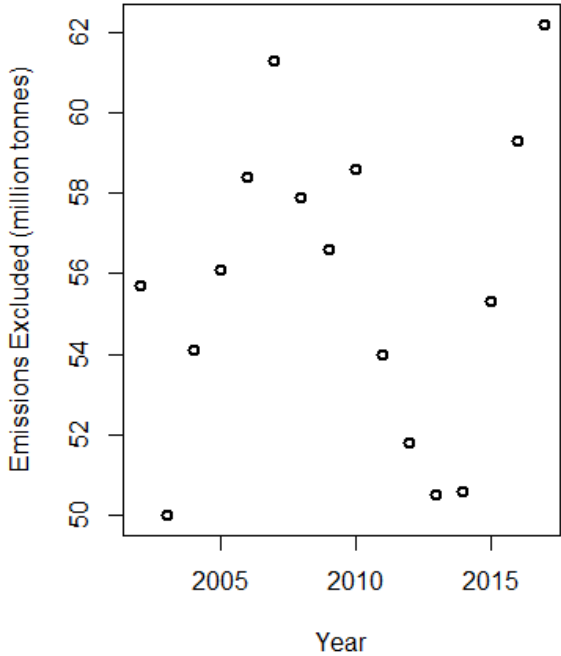
California Agricultural Emissions 2002-2017



California Biogenic Emissions 2002-2017



California Excluded Emissions 2002-2017



Californias Total Emissions 2002-2017

