

aqs

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```
# rm(list=ls())
# cat("\014")
# setwd("C:/Users/ijiang6/Desktop")

#install.packages("MASS")
library(MASS)

## Warning: package 'MASS' was built under R version 3.4.4
#install.packages("faraway")
library(faraway)
#install.packages("nlme")
library(nlme)
library(leaps)
library(Amelia)

## Loading required package: Rcpp
## Warning: package 'Rcpp' was built under R version 3.4.3
## Warning in as.POSIXlt.POSIXct(x, tz): unknown timezone 'zone/tz/2018g.1.0/
## zoneinfo/America/New_York'

## ##
## ### Amelia II: Multiple Imputation
## ### (Version 1.7.4, built: 2015-12-05)
## ### Copyright (C) 2005-2018 James Honaker, Gary King and Matthew Blackwell
## ### Refer to http://gking.harvard.edu/amelia/ for more information
## ##

library(forecast)

## Warning: package 'forecast' was built under R version 3.4.4
##
## Attaching package: 'forecast'
## The following object is masked from 'package:nlme':
## 
##     getResponse
```

Loading Data

```
data_raw <- read.csv("data/data_merged_meso_weather-dropped.csv")
data_raw <- data_raw[!is.na(data_raw$AQI),]

#Loading data
data <- read.csv("data/data_nomiss_Ian.csv")
#Dropping missing values in response
# data <- data[!is.na(data$AQI),]
```

```

#Assigning date from year, month, day
data$date <- as.numeric( difftime(ISOdate(data$Year, data$Month, data$Day, 0), ISOdate(2016,1,1,0), uni

smp_size <- floor(0.80 * nrow(data))

## set the seed to make your partition reproducible
set.seed(123)
train_ind <- sample(seq_len(nrow(data)), size = smp_size)

data_train <- data[train_ind, ]
data_test <- data[-train_ind, ]

data_rel <- subset(data, select = c("AQI", "Nitrous.Oxide", "County", "NF3", "Other.GHG", "Total.Emission"))

table(data$Defining.Parameter)

##
##      CO    NO2 Ozone   PM10 PM2.5    SO2
##      42  2262 81002  5344 50303  4028

```

Based on the above distribution, we decided to build separate models based on “Defining Parameter” value.

```

data_ozone <- data[data$Defining.Parameter == 'Ozone',]
data_PM25 <- data[data$Defining.Parameter == 'PM2.5',]
data_PM10 <- data[data$Defining.Parameter == 'PM10',]
data_SO2 <- data[data$Defining.Parameter == 'SO2',]
data_NO2 <- data[data$Defining.Parameter == 'NO2',]
data_CO <- data[data$Defining.Parameter == 'CO',]

```

Note- update this code to split data for each dataset!!

```

# smp_size <- floor(0.80 * nrow(data))
#
# ## set the seed to make your partition reproducible
# set.seed(123)
# train_ind <- sample(seq_len(nrow(data)), size = smp_size)
#
# data_train <- data[train_ind, ]
# data_test <- data[-train_ind, ]

```

Visualizing data to find out outliers/data issues

```

sapply(data_raw,function(x) sum(is.na(x)))

##                  X                 County          Unnamed..0.1.1
##                  0                  0            219291
##      Temperature          Altimeter Precipitation_24hrAccum
##      60595                105816                   151075
##      RelHumidity        WindSpeed             Year
##      99683                 99254                   0
##      Month                  Day             State
##                  0                  0                   0
##      State.Code        County.Code             AQI
##                  0                  0                   0
##      Category     Defining.Parameter Total.Emissions

```

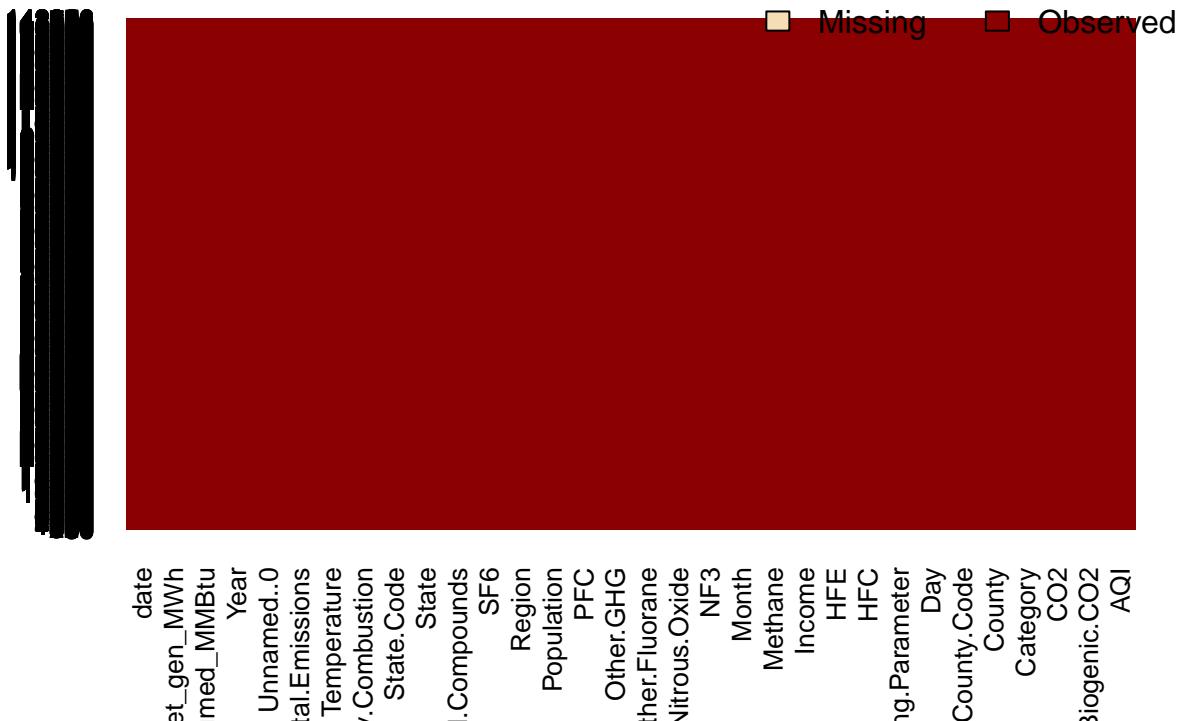
```

##          0          0          43124
##          CO2        Methane    Nitrous.Oxide
##          43124      43124      43124
##          HFC         PFC       SF6
##          43124      43124      43124
##          NF3        Other.Fluorane   HFE
##          43124      43124      43124
##  Short.Lived.Compounds  Other.GHG Biogenic.CO2
##          43124      43124      43124
##  Stationary.Combustion Income      Region
##          43124      1259       728
##          Population pp_consumed_MMBtu pp_net_gen_MWh
##          728        42447      42447

missmap(data, main = "Missing values vs observed")

```

Missing values vs observed



```

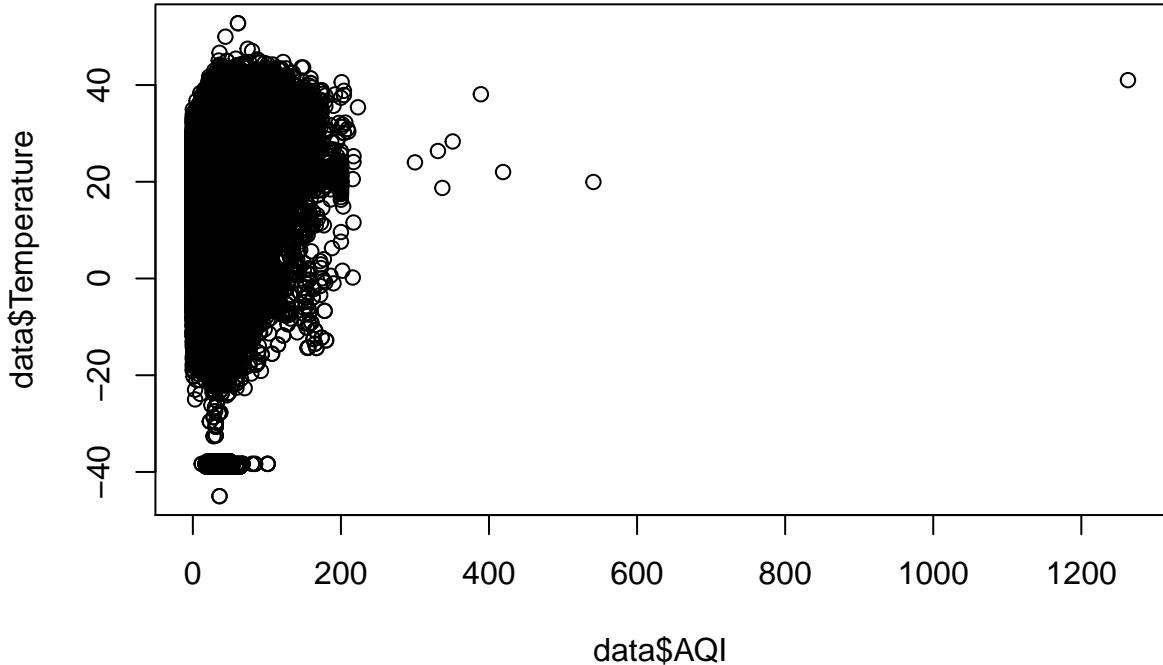
temp.lmod <- lm(formula = AQI ~ Temperature, data=data)
summary(temp.lmod)

```

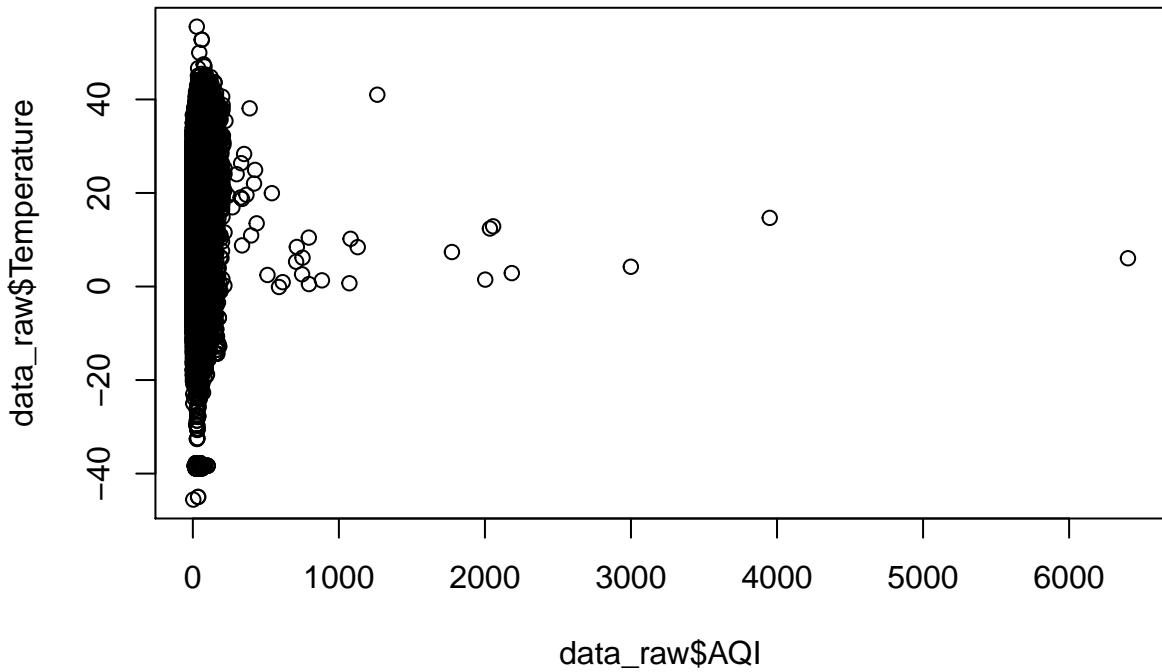
```

##
## Call:
## lm(formula = AQI ~ Temperature, data = data)
##
## Residuals:
##     Min      1Q  Median      3Q     Max 
## -47.34 -11.56  -1.96    6.97 1213.45 
## 
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)    
## (Intercept)  10.0000   10.0000  1.0000  0.3162    
## Temperature -0.0001   0.0001 -0.0001  0.0000    
## 
## AQI
##             Estimate Std. Error t value Pr(>|t|)    
## (Intercept)  10.0000   10.0000  1.0000  0.3162    
## Temperature -0.0001   0.0001 -0.0001  0.0000    
## 
```

```
## (Intercept) 34.629742   0.100049  346.13   <2e-16 ***
## Temperature  0.363665   0.004993   72.84   <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 21.04 on 142979 degrees of freedom
## Multiple R-squared:  0.03578,    Adjusted R-squared:  0.03577
## F-statistic:  5305 on 1 and 142979 DF,  p-value: < 2.2e-16
plot(data$AQI, data$Temperature)
```



```
plot(data_raw$AQI, data_raw$Temperature)
```



```
#data[data$County == 'iberville',]
# data_raw[data_raw$Temperature < -30,]
```

Cleaning Data

```
# data$State.Code <- as.factor(data$State.Code)
```

Fitting full model

```
lmod <- lm(formula = AQI ~ Nitrous.Oxide + NF3 + Other.GHG + Total.Emissions + HFC + Other.Fluorane + Biogenic.CO2 + Population + CO2 + PFC + HFE + Stationary.Combustion + pp_consumed_MMBtu + Temperature + Methane + SF6 + Short.Lived.Compounds + Income + pp_net_gen_MWh,
            data = data_train)

## Call:
## lm(formula = AQI ~ Nitrous.Oxide + NF3 + Other.GHG + Total.Emissions +
##      HFC + Other.Fluorane + Biogenic.CO2 + Population + CO2 +
##      PFC + HFE + Stationary.Combustion + pp_consumed_MMBtu + Temperature +
##      Methane + SF6 + Short.Lived.Compounds + Income + pp_net_gen_MWh,
##      data = data_train)

## Residuals:
##      Min       1Q   Median       3Q      Max 
## -53.61  -11.58   -2.06    7.31 1212.14 

## Coefficients:
## (Intercept) 3.554e+01 3.031e-01 117.243 < 2e-16 ***
## Nitrous.Oxide 7.633e+05 2.185e+05  3.494 0.000476 ***
```

```

## NF3           7.633e+05  2.185e+05   3.494  0.000476 ***
## Other.GHG    7.633e+05  2.185e+05   3.494  0.000476 ***
## Total.Emissions -7.633e+05 2.185e+05  -3.494  0.000476 ***
## HFC            7.633e+05  2.185e+05   3.494  0.000476 ***
## Other.Fluorane 7.633e+05  2.185e+05   3.494  0.000476 ***
## Biogenic.CO2   -4.405e-06 1.808e-07  -24.366 < 2e-16 ***
## Population     6.178e-06  1.016e-07   60.817 < 2e-16 ***
## CO2            7.633e+05  2.185e+05   3.494  0.000476 ***
## PFC             7.633e+05  2.185e+05   3.494  0.000476 ***
## HFE             7.633e+05  2.185e+05   3.494  0.000476 ***
## Stationary.Combustion 9.132e-07 4.974e-08  18.358 < 2e-16 ***
## pp_consumed_MMBtu -5.066e-08 5.890e-08  -0.860  0.389791
## Temperature     3.466e-01  5.664e-03   61.191 < 2e-16 ***
## Methane          7.633e+05  2.185e+05   3.494  0.000476 ***
## SF6              7.633e+05  2.185e+05   3.494  0.000476 ***
## Short.Lived.Compounds 7.633e+05  2.185e+05   3.494  0.000476 ***
## Income            -3.868e-05 5.985e-06  -6.463  1.03e-10 ***
## pp_net_gen_MWh   6.998e-07  5.518e-07   1.268  0.204774
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 20.56 on 114364 degrees of freedom
## Multiple R-squared:  0.08809,   Adjusted R-squared:  0.08794
## F-statistic: 581.5 on 19 and 114364 DF,  p-value: < 2.2e-16

#Fitting full model
full.lmod <- lm(formula = AQI ~ Nitrous.Oxide + County + NF3 + Other.GHG + Total.Emissions + HFC + Other.Fluorane + Biogenic.CO2 + Population + CO2 + PFC + HFE + Stationary.Combustion + pp_consumed_MMBtu + Temperature + Methane + SF6 + Short.Lived.Compounds + Income + pp_net_gen_MWh, data = data_train)

# summary(full.lmod)
summary(full.lmod)$r.squared

## [1] 0.3625084

```

Experimenting with states and county as factors

```

states.lmod <- lm(formula = AQI ~ Nitrous.Oxide + State + NF3 + Other.GHG + Total.Emissions + HFC + Other.Fluorane + Biogenic.CO2 + Population + CO2 + PFC + HFE + Stationary.Combustion + pp_consumed_MMBtu + Temperature + Methane + SF6 + Short.Lived.Compounds + Income + pp_net_gen_MWh, data = data_train)

##
## Call:
## lm(formula = AQI ~ Nitrous.Oxide + State + NF3 + Other.GHG +
##      Total.Emissions + HFC + Other.Fluorane + Biogenic.CO2 + Population +
##      CO2 + PFC + HFE + Stationary.Combustion + pp_consumed_MMBtu +
##      Temperature + Methane + SF6 + Short.Lived.Compounds + Income +
##      pp_net_gen_MWh, data = data_train)
##
## Residuals:
##      Min       1Q     Median      3Q      Max
## -57.62  -11.04   -2.04    7.10 1206.70
##
## Coefficients:
## (Intercept) 3.969e+01  5.238e-01  75.778 < 2e-16 ***
## Estimate Std. Error t value Pr(>|t|)
## (Intercept) 3.969e+01  5.238e-01  75.778 < 2e-16 ***

```

## Nitrous.Oxide	5.285e+05	1.772e+05	2.982	0.002862	**
## Statealaska	-1.567e+00	5.840e-01	-2.683	0.007291	**
## Statearizona	3.739e+00	5.382e-01	6.947	3.76e-12	***
## Statearkansas	-3.940e+00	7.861e-01	-5.012	5.39e-07	***
## Statecalifornia	1.123e+01	4.842e-01	23.192	< 2e-16	***
## Statecolorado	5.240e+00	5.295e-01	9.894	< 2e-16	***
## Stateconnecticut	6.116e+00	6.985e-01	8.757	< 2e-16	***
## Statedelaware	1.787e+00	9.074e-01	1.969	0.048982	*
## Stateflorida	-6.021e+00	4.814e-01	-12.507	< 2e-16	***
## Stategeorgia	-9.967e-01	5.389e-01	-1.850	0.064377	.
## Statehawaii	1.031e+01	7.265e-01	14.190	< 2e-16	***
## Stateidaho	-1.384e+01	6.060e-01	-22.843	< 2e-16	***
## Stateillinois	-3.290e+00	5.524e-01	-5.956	2.59e-09	***
## Stateindiana	-1.695e+00	5.190e-01	-3.265	0.001094	**
## Stateiowa	-3.140e+00	5.886e-01	-5.335	9.58e-08	***
## Statekansas	-8.369e+00	6.871e-01	-12.179	< 2e-16	***
## Statekentucky	-5.345e-01	5.944e-01	-0.899	0.368499	
## Statelouisiana	-2.891e+00	5.656e-01	-5.111	3.21e-07	***
## Statemaine	-5.033e+00	5.921e-01	-8.501	< 2e-16	***
## Statemaryland	3.129e+00	5.737e-01	5.453	4.95e-08	***
## Statemassachusetts	-2.228e+00	6.535e-01	-3.410	0.000651	***
## Statemissouri	-3.312e+01	1.465e+00	-22.604	< 2e-16	***
## Statenorth carolina	-2.468e+01	5.445e+00	-4.534	5.80e-06	***
## Statenorth dakota	-2.613e+01	1.656e+00	-15.783	< 2e-16	***
## Stateohio	-2.843e+00	7.034e-01	-4.041	5.32e-05	***
## Stateoklahoma	-5.073e+00	5.451e-01	-9.306	< 2e-16	***
## Stateoregon	-1.280e+01	5.360e-01	-23.873	< 2e-16	***
## Statepennsylvania	3.392e+00	4.823e-01	7.035	2.01e-12	***
## Staterhode island	6.172e-02	9.219e-01	0.067	0.946627	
## Statesouth carolina	-3.461e+00	5.756e-01	-6.014	1.82e-09	***
## Statetennessee	-1.301e+00	6.168e-01	-2.110	0.034884	*
## Statetexas	-6.665e+00	4.770e-01	-13.974	< 2e-16	***
## Stateutah	6.325e+00	5.915e-01	10.693	< 2e-16	***
## Statevermont	-2.299e+00	9.407e-01	-2.443	0.014549	*
## Statevirginia	-3.113e+00	6.176e-01	-5.041	4.65e-07	***
## Statewashington	-1.350e+01	5.208e-01	-25.931	< 2e-16	***
## Statewest virginia	-5.795e+00	6.841e-01	-8.471	< 2e-16	***
## Statewisconsin	-2.494e+00	5.377e-01	-4.638	3.52e-06	***
## Statewyoming	2.334e+00	5.425e-01	4.302	1.69e-05	***
## NF3	5.285e+05	1.772e+05	2.982	0.002862	**
## Other.GHG	5.285e+05	1.772e+05	2.982	0.002862	**
## Total.Emissions	-5.285e+05	1.772e+05	-2.982	0.002862	**
## HFC	5.285e+05	1.772e+05	2.982	0.002862	**
## Other.Fluorane	5.285e+05	1.772e+05	2.982	0.002862	**
## Biogenic.CO2	-2.638e-06	1.955e-07	-13.497	< 2e-16	***
## Population	4.967e-06	1.021e-07	48.667	< 2e-16	***
## CO2	5.285e+05	1.772e+05	2.982	0.002862	**
## PFC	5.285e+05	1.772e+05	2.982	0.002862	**
## HFE	5.285e+05	1.772e+05	2.982	0.002862	**
## Stationary.Combustion	8.795e-07	4.988e-08	17.630	< 2e-16	***
## pp_consumed_MMBtu	-5.037e-09	5.877e-08	-0.086	0.931693	
## Temperature	3.315e-01	5.861e-03	56.568	< 2e-16	***
## Methane	5.285e+05	1.772e+05	2.982	0.002862	**
## SF6	5.285e+05	1.772e+05	2.982	0.002862	**

```

## Short.Lived.Compounds 5.285e+05 1.772e+05 2.982 0.002862 **
## Income -9.866e-05 6.536e-06 -15.094 < 2e-16 ***
## pp_net_gen_MWh 5.961e-07 5.526e-07 1.079 0.280706
## ---
## Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 19.56 on 114326 degrees of freedom
## Multiple R-squared: 0.1748, Adjusted R-squared: 0.1744
## F-statistic: 424.8 on 57 and 114326 DF, p-value: < 2.2e-16
region.lmod <- lm(formula = AQI ~ State + Nitrous.Oxide + NF3 + Other.GHG + Total.Emissions + HFC + Othe
summary(region.lmod)

##
## Call:
## lm(formula = AQI ~ State + Nitrous.Oxide + NF3 + Other.GHG +
##     Total.Emissions + HFC + Other.Fluorane + Biogenic.CO2 + Population +
##     CO2 + PFC + HFE + Stationary.Combustion + pp_consumed_MMBtu +
##     Temperature + Methane + SF6 + Short.Lived.Compounds + Income +
##     pp_net_gen_MWh, data = data_train)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -57.62  -11.04   -2.04    7.10 1206.70
##
## Coefficients:
##                               Estimate Std. Error t value Pr(>|t|)
## (Intercept) 3.997e+01 5.146e-01 77.678 < 2e-16 ***
## Statealaska -1.642e+00 5.844e-01 -2.810 0.004950 **
## Statearizona 3.561e+00 5.350e-01 6.656 2.82e-11 ***
## Statearkansas -4.233e+00 7.794e-01 -5.431 5.61e-08 ***
## Statecalifornia 1.106e+01 4.808e-01 23.009 < 2e-16 ***
## Statecolorado 5.112e+00 5.282e-01 9.677 < 2e-16 ***
## Stateconnecticut 5.936e+00 6.964e-01 8.523 < 2e-16 ***
## Statedelaware 1.505e+00 9.020e-01 1.669 0.095142 .
## Stateflorida -6.206e+00 4.770e-01 -13.012 < 2e-16 ***
## Stategeorgia -1.119e+00 5.386e-01 -2.078 0.037698 *
## Statehawaii 1.018e+01 7.258e-01 14.031 < 2e-16 ***
## Stateidaho -1.386e+01 6.064e-01 -22.862 < 2e-16 ***
## Stateillinois -3.465e+00 5.490e-01 -6.312 2.76e-10 ***
## Stateindiana -1.745e+00 5.191e-01 -3.362 0.000773 ***
## Stateiowa -3.309e+00 5.859e-01 -5.648 1.63e-08 ***
## Statekansas -8.506e+00 6.870e-01 -12.381 < 2e-16 ***
## Statekentucky -6.680e-01 5.934e-01 -1.126 0.260256
## Statelouisiana -3.045e+00 5.630e-01 -5.409 6.36e-08 ***
## Statemaine -5.365e+00 5.820e-01 -9.219 < 2e-16 ***
## Statemaryland 2.960e+00 5.722e-01 5.173 2.31e-07 ***
## Statemassachusetts -2.453e+00 6.486e-01 -3.782 0.000155 ***
## Statemissouri -3.325e+01 1.470e+00 -22.626 < 2e-16 ***
## Statenorth carolina -2.476e+01 5.445e+00 -4.548 5.42e-06 ***
## Statenorth dakota -2.642e+01 1.653e+00 -15.989 < 2e-16 ***
## Stateohio -3.006e+00 7.015e-01 -4.285 1.83e-05 ***
## Stateoklahoma -5.272e+00 5.407e-01 -9.750 < 2e-16 ***
## Stateoregon -1.298e+01 5.321e-01 -24.400 < 2e-16 ***

```

```

## Statepennsylvania      3.206e+00  4.786e-01   6.699 2.11e-11 ***
## Staterhode island     -3.438e-01 9.112e-01  -0.377 0.705959
## Statesouth carolina   -3.664e+00  5.712e-01  -6.414 1.43e-10 ***
## Statetennessee        -1.396e+00  6.174e-01  -2.261 0.023764 *
## Statetexas             -6.942e+00  4.678e-01 -14.840 < 2e-16 ***
## Stateutah              6.076e+00  5.850e-01  10.385 < 2e-16 ***
## Statevermont           -2.242e+00  9.430e-01  -2.378 0.017411 *
## Statevirginia          -3.337e+00  6.125e-01  -5.448 5.10e-08 ***
## Statewashingtton        -1.367e+01  5.177e-01  -26.397 < 2e-16 ***
## Statewest virginia    -5.794e+00  6.841e-01  -8.469 < 2e-16 ***
## Statewisconsin         -2.555e+00  5.374e-01  -4.754 2.00e-06 ***
## Statewyoming            2.340e+00  5.427e-01   4.312 1.62e-05 ***
## Nitrous.Oxide          -6.235e+04  6.537e+04  -0.954 0.340202
## NF3                   -6.235e+04  6.537e+04  -0.954 0.340202
## Other.GHG              6.235e+04  6.537e+04  -0.954 0.340202
## Total.Emissions         6.235e+04  6.537e+04  0.954 0.340202
## HFC                   -6.235e+04  6.537e+04  -0.954 0.340202
## Other.Fluorane         -6.235e+04  6.537e+04  -0.954 0.340202
## Biogenic.CO2            2.639e-06  1.955e-07 -13.501 < 2e-16 ***
## Population             4.980e-06  1.020e-07  48.830 < 2e-16 ***
## CO2                   -6.235e+04  6.537e+04  -0.954 0.340202
## PFC                   -6.235e+04  6.537e+04  -0.954 0.340202
## HFE                   -6.235e+04  6.537e+04  -0.954 0.340202
## Stationary.Combustion  8.793e-07  4.989e-08  17.626 < 2e-16 ***
## pp_consumed_MMBtu     -6.103e-09  5.877e-08  -0.104 0.917292
## Temperature            3.316e-01  5.861e-03   56.572 < 2e-16 ***
## Methane                -6.235e+04  6.537e+04  -0.954 0.340202
## SF6                   -6.235e+04  6.537e+04  -0.954 0.340202
## Short.Lived.Compounds -6.235e+04  6.537e+04  -0.954 0.340213
## Income                 -9.865e-05  6.537e-06 -15.092 < 2e-16 ***
## pp_net_gen_MWh         6.072e-07  5.526e-07   1.099 0.271896
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 19.56 on 114326 degrees of freedom
## Multiple R-squared:  0.1747, Adjusted R-squared:  0.1743
## F-statistic: 424.7 on 57 and 114326 DF, p-value: < 2.2e-16

```

Prediction accuracy

```

AQI_pred <- predict(full.lmod, data_test)
accuracy(AQI_pred, data_test$AQI)

##               ME      RMSE      MAE MPE MAPE
## Test set 0.07247373 16.59975 11.49727 NaN  Inf

AQI_pred <- predict(lmod, data_test)
accuracy(AQI_pred, data_test$AQI)

##               ME      RMSE      MAE MPE MAPE
## Test set 0.1171596 20.07604 13.64517 -Inf  Inf

```

Trying out stepwise regression

PS - check this, it gives error!!!

```
# step.mod = regsubsets(AQI ~., data = data_train, really.big = T, method='forward')
```

PCR

```
# pcr.lmod <- pcr(AQI~., data=data_rel, scale=T, ncomp = 10, validation = "CV")
```

Ridge/Lasso Regression

```
# ridge.lmod <- lm.ridge(AQI ~ Nitrous.Oxide + NF3 + Other.GHG + Total.Emissions + HFC + Other.Fluorane  
#  
# select(ridge.lmod)  
# summary(ridge.lmod)
```

Different models based on Defining Parameter

Defining Parameter = Ozone

```
ozone.lmod <- lm(formula = AQI ~ Nitrous.Oxide + NF3 + Other.GHG + Total.Emissions + HFC + Other.Fluorane  
  
summary(ozone.lmod)  
  
##  
## Call:  
## lm(formula = AQI ~ Nitrous.Oxide + NF3 + Other.GHG + Total.Emissions +  
##       HFC + Other.Fluorane + Biogenic.CO2 + Population + CO2 +  
##       PFC + HFE + Stationary.Combustion + pp_consumed_MMBtu + Temperature +  
##       Methane + SF6 + Short.Lived.Compounds + Income + pp_net_gen_MWh,  
##       data = data_ozone)  
##  
## Residuals:  
##      Min      1Q Median      3Q     Max  
## -56.411 -9.932 -2.445  4.978 182.798  
##  
## Coefficients:  
##                               Estimate Std. Error t value Pr(>|t|)  
## (Intercept)            3.431e+01  3.096e-01 110.821  < 2e-16 ***  
## Nitrous.Oxide          2.003e+04  6.673e+04   0.300  0.764062  
## NF3                   2.003e+04  6.673e+04   0.300  0.764062  
## Other.GHG              2.003e+04  6.673e+04   0.300  0.764062  
## Total.Emissions        -2.003e+04 6.673e+04  -0.300  0.764062  
## HFC                   2.003e+04  6.673e+04   0.300  0.764062  
## Other.Fluorane         2.003e+04  6.673e+04   0.300  0.764062  
## Biogenic.CO2           -3.268e-06 2.117e-07 -15.434  < 2e-16 ***  
## Population            6.626e-06 1.099e-07  60.291  < 2e-16 ***  
## CO2                  2.003e+04  6.673e+04   0.300  0.764062  
## PFC                  2.003e+04  6.673e+04   0.300  0.764062
```

```

## HFE           2.003e+04 6.673e+04 0.300 0.764062
## Stationary.Combustion -2.080e-07 5.452e-08 -3.815 0.000136 ***
## pp_consumed_MMBtu    2.796e-07 6.101e-08 4.583 4.59e-06 ***
## Temperature        4.968e-01 6.051e-03 82.106 < 2e-16 ***
## Methane          2.003e+04 6.673e+04 0.300 0.764062
## SF6             2.003e+04 6.673e+04 0.300 0.764062
## Short.Lived.Compounds 2.003e+04 6.673e+04 0.300 0.764035
## Income          -4.904e-05 5.949e-06 -8.244 < 2e-16 ***
## pp_net_gen_MWh     -3.144e-06 5.734e-07 -5.483 4.19e-08 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 17.26 on 80982 degrees of freedom
## Multiple R-squared:  0.1407, Adjusted R-squared:  0.1405
## F-statistic:   698 on 19 and 80982 DF, p-value: < 2.2e-16
ozone_geo.lmod <- lm(formula = AQI ~ County + Nitrous.Oxide + NF3 + Other.GHG + Total.Emissions + HFC +
summary(ozone_geo.lmod)

##
## Call:
## lm(formula = AQI ~ County + Nitrous.Oxide + NF3 + Other.GHG +
##     Total.Emissions + HFC + Other.Fluorane + Biogenic.CO2 + Population +
##     CO2 + PFC + HFE + Stationary.Combustion + pp_consumed_MMBtu +
##     Temperature + Methane + SF6 + Short.Lived.Compounds + Income +
##     pp_net_gen_MWh, data = data_ozone)
##
## Residuals:
##      Min       1Q     Median      3Q      Max 
## -60.124  -8.786  -1.782   5.385 170.965 
##
## Coefficients:
##                               Estimate Std. Error t value Pr(>|t|)    
## (Intercept)               4.679e+01 5.151e+01  0.908  0.3636    
## Countyadams            -1.546e+01 5.143e+01 -0.301  0.7636    
## Countyaiken            -2.365e+01 5.145e+01 -0.460  0.6458    
## Countyalachua         -2.447e+01 5.144e+01 -0.476  0.6343    
## Countyalameda         -2.604e+01 5.214e+01 -0.499  0.6175    
## Countyalbany          -3.878e+00 5.136e+01 -0.076  0.9398    
## Countyallegheny        -1.898e+01 5.189e+01 -0.366  0.7146    
## Countyanderson        -2.120e+01 5.138e+01 -0.413  0.6799    
## Countyarapahoe        -1.552e+01 5.163e+01 -0.301  0.7637    
## Countyarmstrong       -1.338e+01 5.129e+01 -0.261  0.7942    
## Countyaroostook       -2.236e+01 5.139e+01 -0.435  0.6635    
## Countyascension        -2.600e+01 5.147e+01 -0.505  0.6135    
## Countyashland          -2.052e+01 5.136e+01 -0.399  0.6895    
## Countybaltimore        -1.373e+01 5.172e+01 -0.265  0.7907    
## Countybarnstable       -2.066e+01 5.135e+01 -0.402  0.6874    
## Countybay              -2.194e+01 5.140e+01 -0.427  0.6694    
## Countybeaver           -1.015e+01 5.119e+01 -0.198  0.8429    
## Countybell             -2.676e+01 5.148e+01 -0.520  0.6032    
## Countybenton           -2.113e+01 5.143e+01 -0.411  0.6811    
## Countyberkeley          -2.375e+01 5.132e+01 -0.463  0.6435    
## Countyberks            -1.687e+01 5.152e+01 -0.327  0.7433

```

## Countybexar	-3.424e+01	4.298e+01	-0.797	0.4257
## Countybibb	-2.196e+01	5.146e+01	-0.427	0.6695
## Countyblair	-1.771e+01	5.140e+01	-0.345	0.7304
## Countyblount	-1.985e+01	5.143e+01	-0.386	0.6996
## Countyboone	-2.145e+01	5.133e+01	-0.418	0.6761
## Countyboulder	-2.019e+01	5.141e+01	-0.393	0.6944
## Countybradford	-2.022e+01	5.139e+01	-0.393	0.6940
## Countybrazoria	-2.969e+01	5.166e+01	-0.575	0.5655
## Countybrevard	-2.230e+01	3.800e+01	-0.587	0.5574
## Countybristol	-2.215e+01	5.155e+01	-0.430	0.6675
## Countybroward	-3.631e+01	5.226e+01	-0.695	0.4872
## Countybrown	-2.468e+01	5.147e+01	-0.480	0.6316
## Countybucks	-2.437e+01	5.151e+01	-0.473	0.6362
## Countybutte	-8.826e+00	5.145e+01	-0.172	0.8638
## Countycabell	-2.444e+01	5.143e+01	-0.475	0.6346
## Countycache	-1.463e+01	5.145e+01	-0.284	0.7761
## Countycaddo	-3.090e+01	5.143e+01	-0.601	0.5480
## Countycalcasieu	-1.735e+01	5.137e+01	-0.338	0.7356
## Countycalvert	-1.481e+01	5.131e+01	-0.289	0.7729
## Countycambria	-1.746e+01	5.139e+01	-0.340	0.7341
## Countycameron	-3.059e+01	5.164e+01	-0.592	0.5536
## Countycampbell	-1.547e+01	5.119e+01	-0.302	0.7625
## Countycanadian	-2.364e+01	5.141e+01	-0.460	0.6456
## Countycarbon	-1.030e+01	5.135e+01	-0.200	0.8411
## Countycecil	-1.256e+01	5.138e+01	-0.244	0.8069
## Countycentre	-1.730e+01	5.142e+01	-0.336	0.7365
## Countychampaign	-2.007e+01	5.145e+01	-0.390	0.6965
## Countycharles	-1.652e+01	5.130e+01	-0.322	0.7474
## Countycharleston	-2.592e+01	5.153e+01	-0.503	0.6150
## Countychatham	-2.464e+01	5.153e+01	-0.478	0.6325
## Countycherokee	-2.076e+01	5.149e+01	-0.403	0.6868
## Countychester	-1.834e+01	5.151e+01	-0.356	0.7218
## Countychesterfield	-2.386e+01	5.136e+01	-0.465	0.6422
## Countychittenden	-2.105e+01	1.281e+02	-0.164	0.8695
## Countyclackamas	-2.808e+01	5.152e+01	-0.545	0.5858
## Countyclark	-2.299e+01	5.144e+01	-0.447	0.6549
## Countyclarke	-2.129e+01	5.148e+01	-0.414	0.6792
## Countyclearfield	-2.223e+01	5.139e+01	-0.433	0.6654
## Countycleveland	-2.249e+01	5.148e+01	-0.437	0.6623
## Countyclinton	-1.851e+01	5.141e+01	-0.360	0.7188
## Countycobb	-1.703e+01	5.145e+01	-0.331	0.7406
## Countycochise	-1.663e+01	5.139e+01	-0.324	0.7463
## Countycocoonino	-1.186e+01	5.119e+01	-0.232	0.8168
## Countycolbert	-2.362e+01	5.139e+01	-0.460	0.6458
## Countycollier	-2.928e+01	5.136e+01	-0.570	0.5687
## Countycollin	-3.165e+01	4.865e+01	-0.651	0.5153
## Countycolumbia	-2.547e+01	5.133e+01	-0.496	0.6197
## Countycolusa	-1.876e+01	5.130e+01	-0.366	0.7146
## Countycomanche	-2.256e+01	5.143e+01	-0.439	0.6609
## Countycontracosta	-3.287e+01	5.167e+01	-0.636	0.5246
## Countyconverse	-1.364e+01	5.120e+01	-0.266	0.7899
## Countycook	-4.887e+01	5.414e+01	-0.903	0.3667
## Countycoweta	-1.634e+01	5.147e+01	-0.317	0.7510
## Countycumberland	-5.781e+00	3.534e+01	-0.164	0.8701

## Countydallas	3.880e+00	1.223e+02	0.032	0.9747
## Countydane	-2.537e+01	5.158e+01	-0.492	0.6228
## Countydarlington	-1.986e+01	5.139e+01	-0.387	0.6991
## Countydauphin	-1.893e+01	5.145e+01	-0.368	0.7129
## Countydavidson	-1.888e+01	5.166e+01	-0.365	0.7148
## Countydaviess	-1.249e+01	5.140e+01	-0.243	0.8080
## Countydavis	-1.539e+01	5.153e+01	-0.299	0.7653
## Countydekalb	-1.855e+01	5.153e+01	-0.360	0.7188
## Countydelaware	-1.200e+01	5.147e+01	-0.233	0.8156
## Countydenali	-1.927e+01	5.122e+01	-0.376	0.7067
## Countydenton	-2.528e+01	5.179e+01	-0.488	0.6255
## Countydenver	-1.404e+01	5.161e+01	-0.272	0.7855
## Countydodge	-2.088e+01	5.141e+01	-0.406	0.6846
## Countydorchester	-1.684e+01	5.137e+01	-0.328	0.7430
## Countydouglas	-8.323e+00	5.140e+01	-0.162	0.8714
## Countyduchesne	-6.618e+00	5.139e+01	-0.129	0.8975
## Countydupage	-2.426e+01	5.173e+01	-0.469	0.6391
## Countyduval	-2.681e+01	5.160e+01	-0.520	0.6033
## Countyeffingham	-4.977e-01	5.154e+01	-0.010	0.9923
## Countyelk	-1.992e+01	5.136e+01	-0.388	0.6981
## Countyelkhart	-1.565e+01	5.147e+01	-0.304	0.7611
## Countyellis	-2.363e+01	5.138e+01	-0.460	0.6456
## Countyelmore	-2.165e+01	5.140e+01	-0.421	0.6736
## Countyerie	-1.776e+01	5.151e+01	-0.345	0.7302
## Countyescambia	-1.246e+01	5.491e+01	-0.227	0.8204
## Countyessex	-2.329e+01	5.167e+01	-0.451	0.6522
## Countyetowah	-1.424e+01	5.143e+01	-0.277	0.7818
## Countyfairbanksnorthstar	-3.293e+01	5.135e+01	-0.641	0.5214
## Countyfairfax	-2.460e+01	5.181e+01	-0.475	0.6349
## Countyfairfield	-5.682e+00	5.154e+01	-0.110	0.9122
## Countyfauquier	-2.596e+01	5.127e+01	-0.506	0.6126
## Countyfayette	-2.115e+01	5.151e+01	-0.411	0.6814
## Countyfloyd	-1.475e+01	5.146e+01	-0.287	0.7744
## Countyfranklin	-2.287e+01	5.139e+01	-0.445	0.6563
## Countyfrederick	-1.890e+01	5.140e+01	-0.368	0.7132
## Countyfremont	-1.004e+01	5.136e+01	-0.196	0.8450
## Countyfresno	1.715e+01	5.187e+01	0.331	0.7409
## Countyfulton	-1.288e+01	5.177e+01	-0.249	0.8036
## Countygalveston	-2.124e+01	5.140e+01	-0.413	0.6794
## Countygarfield	-5.922e+00	5.131e+01	-0.115	0.9081
## Countygarrett	-1.434e+01	5.136e+01	-0.279	0.7801
## Countygila	-8.577e+00	5.141e+01	-0.167	0.8675
## Countygiles	-1.545e+01	5.138e+01	-0.301	0.7636
## Countyglynn	-2.834e+01	5.140e+01	-0.551	0.5814
## Countygoshen	-1.606e+01	5.135e+01	-0.313	0.7545
## Countygreenup	-1.448e+01	5.138e+01	-0.282	0.7781
## Countygreenville	-2.115e+01	5.164e+01	-0.410	0.6821
## Countygregg	-2.633e+01	5.140e+01	-0.512	0.6085
## Countygunnison	-8.920e+00	5.140e+01	-0.174	0.8622
## Countygwinnett	-2.321e+01	5.185e+01	-0.448	0.6544
## Countyhamilton	-1.547e+01	5.145e+01	-0.301	0.7636
## Countyhampden	-2.041e+01	5.155e+01	-0.396	0.6922
## Countyhancock	-1.539e+01	5.140e+01	-0.299	0.7647
## Countyhanover	-2.142e+01	5.132e+01	-0.417	0.6764

## Countyhardin	-1.110e+01	5.144e+01	-0.216	0.8292
## Countyharford	-1.174e+01	5.142e+01	-0.228	0.8194
## Countyharris	-5.193e+01	5.356e+01	-0.970	0.3323
## Countyharrison	-2.422e+01	5.123e+01	-0.473	0.6364
## Countyhartford	-1.936e+01	5.175e+01	-0.374	0.7083
## Countyhenderson	-1.157e+01	5.146e+01	-0.225	0.8220
## Countyhendricks	-1.821e+01	5.146e+01	-0.354	0.7235
## Countyhenrico	-2.235e+01	5.144e+01	-0.435	0.6639
## Countyhidalgo	-4.109e+01	5.185e+01	-0.793	0.4280
## Countyhillsborough	-2.414e+01	5.180e+01	-0.466	0.6411
## Countyhonolulu	-3.556e+01	5.184e+01	-0.686	0.4927
## Countyhood	-2.580e+01	5.131e+01	-0.503	0.6151
## Countyhorry	-3.764e+01	5.157e+01	-0.730	0.4655
## Countyhouston	-2.665e+01	5.141e+01	-0.518	0.6042
## Countyhumboldt	-2.427e+01	5.141e+01	-0.472	0.6369
## Countyhunt	-2.716e+01	5.144e+01	-0.528	0.5974
## Countyiberville	8.898e+00	5.131e+01	0.173	0.8623
## Countyimperial	-2.215e+00	5.144e+01	-0.043	0.9657
## Countyindiana	-1.237e+01	5.108e+01	-0.242	0.8087
## Countyjackson	-2.828e+01	5.147e+01	-0.549	0.5827
## Countyjefferson	-1.868e+01	5.149e+01	-0.363	0.7167
## Countyjohnson	-2.541e+01	5.151e+01	-0.493	0.6218
## Countykanawha	-2.176e+01	5.154e+01	-0.422	0.6729
## Countykane	-2.370e+01	5.160e+01	-0.459	0.6460
## Countykaufman	-2.468e+01	5.131e+01	-0.481	0.6305
## Countykay	-2.054e+01	5.138e+01	-0.400	0.6894
## Countykennebec	-2.232e+01	5.140e+01	-0.434	0.6642
## Countykenosha	-9.854e+00	5.130e+01	-0.192	0.8477
## Countykent	-1.732e+01	5.143e+01	-0.337	0.7363
## Countykern	1.931e+01	5.162e+01	0.374	0.7084
## Countyking	-4.090e+01	5.235e+01	-0.781	0.4346
## Countykings	9.327e+00	5.147e+01	0.181	0.8562
## Countyknox	-2.052e+01	5.145e+01	-0.399	0.6901
## Countylackawanna	-1.674e+01	5.149e+01	-0.325	0.7451
## Countylafayette	-2.700e+01	5.147e+01	-0.524	0.5999
## Countylake	-2.520e+01	5.149e+01	-0.489	0.6246
## Countylancaster	-1.628e+01	5.163e+01	-0.315	0.7525
## Countylane	-2.917e+01	5.156e+01	-0.566	0.5716
## Countylapaz	-1.581e+01	5.140e+01	-0.308	0.7584
## Countylaporte	-2.019e+01	5.138e+01	-0.393	0.6944
## Countylaramie	-1.145e+01	5.136e+01	-0.223	0.8236
## Countylarimer	1.662e+01	2.502e+01	0.664	0.5065
## Countylawrence	-2.279e+01	5.137e+01	-0.444	0.6573
## Countylebanon	-1.210e+01	5.137e+01	-0.236	0.8138
## Countylee	-2.788e+01	5.153e+01	-0.541	0.5886
## Countylehigh	-1.988e+01	5.150e+01	-0.386	0.6995
## Countyleon	-2.872e+01	5.150e+01	-0.558	0.5770
## Countylinn	-1.772e+01	5.147e+01	-0.344	0.7306
## Countylitchfield	-1.410e+01	5.136e+01	-0.274	0.7837
## Countylorain	-2.138e+01	5.150e+01	-0.415	0.6780
## Countylosangeles	-5.885e+01	5.677e+01	-1.037	0.2999
## Countylucas	-1.823e+01	5.154e+01	-0.354	0.7235
## Countyluzerne	-1.569e+01	4.649e+01	-0.338	0.7357
## Countylycoming	-1.955e+01	5.140e+01	-0.380	0.7037

## Countymacon	-2.270e+01	5.149e+01	-0.441	0.6594
## Countymadera	6.808e+00	5.145e+01	0.132	0.8947
## Countymadison	-1.729e+01	5.145e+01	-0.336	0.7368
## Countymahoning	-2.693e+01	5.151e+01	-0.523	0.6012
## Countymanatee	-2.938e+01	5.144e+01	-0.571	0.5679
## Countymanitowoc	-1.422e+01	5.134e+01	-0.277	0.7818
## Countymarathon	-2.261e+01	5.132e+01	-0.440	0.6596
## Countymaricopa	1.649e+01	5.716e+01	0.289	0.7729
## Countymarin	-3.505e+01	5.121e+01	-0.684	0.4937
## Countymarion	-2.364e+01	5.161e+01	-0.458	0.6469
## Countymartin	-2.376e+01	5.113e+01	-0.465	0.6421
## Countymatanuskasusitna	-2.759e+01	5.138e+01	-0.537	0.5912
## Countymayes	-2.197e+01	5.128e+01	-0.428	0.6683
## Countymcclain	-2.262e+01	5.133e+01	-0.441	0.6594
## Countymccracken	-2.045e+01	5.126e+01	-0.399	0.6899
## Countymchenry	-2.060e+01	5.147e+01	-0.400	0.6890
## Countymclean	-2.034e+01	5.141e+01	-0.396	0.6923
## Countymclennan	-2.938e+01	5.144e+01	-0.571	0.5679
## Countymered	-5.417e+00	5.151e+01	-0.105	0.9162
## Countymercer	-1.467e+01	5.142e+01	-0.285	0.7754
## Countymesa	-1.341e+01	5.144e+01	-0.261	0.7943
## Countymiamidade	-2.735e+01	5.252e+01	-0.521	0.6025
## Countymiddlesex	-6.182e+00	5.128e+01	-0.121	0.9040
## Countymilwaukee	-2.212e+01	5.162e+01	-0.429	0.6682
## Countymobile	-2.344e+01	5.131e+01	-0.457	0.6478
## Countymoffat	-1.400e+01	5.120e+01	-0.273	0.7845
## Countymonongalia	-2.717e+01	5.156e+01	-0.527	0.5982
## Countymonroe	-1.774e+01	5.144e+01	-0.345	0.7302
## Countymonterey	-2.826e+01	5.151e+01	-0.549	0.5833
## Countymontezuma	-7.406e+00	5.137e+01	-0.144	0.8854
## Countymontgomery	-2.389e+01	5.162e+01	-0.463	0.6434
## Countymontrose	-1.604e+01	5.139e+01	-0.312	0.7549
## Countymorgan	5.878e+04	7.632e+04	0.770	0.4412
## Countymultnomah	4.532e+02	5.814e+02	0.780	0.4356
## Countymurray	-1.649e+01	5.136e+01	-0.321	0.7481
## Countymuscogee	-2.753e+01	5.148e+01	-0.535	0.5928
## Countynapa	-2.807e+01	5.133e+01	-0.547	0.5845
## Countynatrona	-1.537e+01	5.128e+01	-0.300	0.7644
## Countynavajo	-1.567e+01	5.141e+01	-0.305	0.7605
## Countyneosho	-2.617e+01	5.138e+01	-0.509	0.6105
## Countynorthhampton	-1.246e+01	5.129e+01	-0.243	0.8081
## Countynueces	-3.297e+01	5.149e+01	-0.640	0.5220
## Countyoklahoma	-2.447e+01	5.172e+01	-0.473	0.6362
## Countyoldham	-2.006e+01	5.135e+01	-0.391	0.6961
## Countyorange	-2.990e+01	5.137e+01	-0.582	0.5606
## Countyosage	-2.210e+01	5.143e+01	-0.430	0.6673
## Countyosceola	-2.945e+01	5.166e+01	-0.570	0.5686
## Countyyouachita	-2.731e+01	5.139e+01	-0.531	0.5951
## Countyoutagamie	-2.519e+01	5.141e+01	-0.490	0.6241
## Countyoxford	-2.545e+01	5.139e+01	-0.495	0.6204
## Countyozaukee	-1.645e+01	5.117e+01	-0.321	0.7479
## Countyparker	-2.516e+01	5.139e+01	-0.489	0.6245
## Countypasco	-2.737e+01	5.157e+01	-0.531	0.5956
## Countypenobscot	-2.226e+01	5.143e+01	-0.433	0.6652

## Countypeoria	-1.942e+01	5.141e+01	-0.378	0.7056
## Countyperry	-1.722e+01	5.138e+01	-0.335	0.7374
## Countyphiladelphia	-2.016e+01	5.211e+01	-0.387	0.6989
## Countypickens	-2.269e+01	5.146e+01	-0.441	0.6593
## Countypierce	-2.442e+01	5.178e+01	-0.472	0.6372
## Countypima	-2.306e+01	5.190e+01	-0.444	0.6568
## Countypinal	-5.902e+00	5.165e+01	-0.114	0.9090
## Countypinellas	-2.788e+01	5.175e+01	-0.539	0.5901
## Countypittsburg	-2.311e+01	5.139e+01	-0.450	0.6528
## Countyplacer	4.414e+00	3.636e+01	0.121	0.9034
## Countypolk	-2.528e+01	5.153e+01	-0.491	0.6236
## Countyporter	-1.514e+01	5.136e+01	-0.295	0.7681
## Countyposey	-2.014e+01	5.131e+01	-0.392	0.6947
## Countyprovidence	-2.014e+01	5.163e+01	-0.390	0.6965
## Countypulaski	-2.057e+01	5.145e+01	-0.400	0.6893
## Countyracine	-1.524e+01	5.144e+01	-0.296	0.7670
## Countyrandolph	-1.727e+01	5.126e+01	-0.337	0.7362
## Countyrichland	-2.125e+01	5.152e+01	-0.413	0.6799
## Countyrichmond	-2.289e+01	5.157e+01	-0.444	0.6572
## Countyriverside	1.561e+01	5.563e+01	0.281	0.7791
## Countyroanoke	-2.019e+01	5.139e+01	-0.393	0.6944
## Countyrock	-2.241e+01	5.151e+01	-0.435	0.6636
## Countyrockdale	-1.550e+01	5.143e+01	-0.301	0.7632
## Countyrockingham	-2.159e+01	5.141e+01	-0.420	0.6745
## Countyrussell	-1.823e+01	5.143e+01	-0.354	0.7231
## Countyrutland	-2.193e+01	5.134e+01	-0.427	0.6692
## Countysacramento	-1.739e+01	5.207e+01	-0.334	0.7384
## Countysangamon	-2.317e+01	5.140e+01	-0.451	0.6522
## Countysarasota	-2.596e+01	5.152e+01	-0.504	0.6144
## Countysauk	-2.284e+01	5.137e+01	-0.445	0.6566
## Countyscott	-1.697e+01	5.141e+01	-0.330	0.7414
## Countysesedwick	-2.549e+01	5.160e+01	-0.494	0.6213
## Countyseminole	-2.976e+01	5.161e+01	-0.577	0.5641
## Countysequoyah	-2.401e+01	5.141e+01	-0.467	0.6405
## Countyshasta	-1.388e+01	5.142e+01	-0.270	0.7872
## Countyshawnee	-2.553e+01	5.143e+01	-0.496	0.6196
## Countysheboygan	-1.432e+01	5.131e+01	-0.279	0.7801
## Countyshelby	-2.273e+01	5.153e+01	-0.441	0.6591
## Countysheridan	-1.601e+01	5.131e+01	-0.312	0.7550
## Countyskagit	-2.348e+01	5.137e+01	-0.457	0.6476
## Countysolano	-2.725e+01	5.154e+01	-0.529	0.5970
## Countysomerset	-1.909e+01	5.141e+01	-0.371	0.7104
## Countysonoma	-3.216e+01	5.154e+01	-0.624	0.5327
## Countyspartanburg	-1.541e+01	5.153e+01	-0.299	0.7649
## Countyspokane	-2.709e+01	5.161e+01	-0.525	0.5997
## Countystafford	-2.383e+01	5.141e+01	-0.464	0.6430
## Countystanislaus	-6.586e+00	5.162e+01	-0.128	0.8985
## Countystory	-2.517e+01	5.140e+01	-0.490	0.6244
## Countysullivan	-2.006e+01	5.154e+01	-0.389	0.6971
## Countysussex	-1.682e+01	5.146e+01	-0.327	0.7437
## Countysutter	1.765e-01	5.139e+01	0.003	0.9973
## Countysweetwater	-1.188e+01	5.114e+01	-0.232	0.8163
## Countytarrant	-3.484e+01	5.241e+01	-0.665	0.5062
## Countytehama	-4.003e+00	5.139e+01	-0.078	0.9379

## Countytioga	-1.581e+01	5.138e+01	-0.308	0.7583
## Countytolland	-1.682e+01	5.138e+01	-0.327	0.7434
## Countytooele	-1.312e+01	5.143e+01	-0.255	0.7987
## Countytravis	3.622e+01	2.630e+02	0.138	0.8905
## Countytucker	-1.627e+01	5.138e+01	-0.317	0.7515
## Countytulare	2.872e+01	5.161e+01	0.557	0.5778
## Countytulsa	-2.297e+01	5.160e+01	-0.445	0.6562
## Countytuscaloosa	-2.847e+01	5.221e+01	-0.545	0.5856
## Countyuinta	-1.207e+01	5.136e+01	-0.235	0.8142
## Countyuintah	-3.226e+00	5.135e+01	-0.063	0.9499
## Countyumatilla	-2.083e+01	5.134e+01	-0.406	0.6849
## Countyutah	6.019e+01	1.050e+01	5.735	9.78e-09 ***
## Countyvanderburgh	-1.749e+01	5.144e+01	-0.340	0.7339
## Countyventura	-1.500e+01	5.176e+01	-0.290	0.7720
## Countyvictoria	-2.857e+01	5.150e+01	-0.555	0.5791
## Countyvigo	-2.268e+01	5.144e+01	-0.441	0.6592
## Countyvolusia	-2.698e+01	5.158e+01	-0.523	0.6009
## Countywabash	-1.947e+01	5.137e+01	-0.379	0.7046
## Countywakulla	-2.375e+01	5.138e+01	-0.462	0.6439
## Countywarren	-2.510e+01	5.138e+01	-0.488	0.6252
## Countywarrick	-1.536e+01	5.127e+01	-0.300	0.7645
## Countywasco	-2.525e+01	5.136e+01	-0.492	0.6230
## Countywashington	-1.830e+01	5.142e+01	-0.356	0.7219
## Countywebb	-3.375e+01	5.158e+01	-0.654	0.5129
## Countyweber	-8.863e+00	5.149e+01	-0.172	0.8634
## Countyweld	-1.216e+01	5.151e+01	-0.236	0.8134
## Countywestmoreland	-1.393e+01	5.154e+01	-0.270	0.7869
## Countywhatcom	-2.131e+01	5.234e+01	-0.407	0.6838
## Countywill	-2.099e+01	5.156e+01	-0.407	0.6839
## Countywindham	-1.859e+01	5.133e+01	-0.362	0.7172
## Countywinnebago	-3.015e+01	5.153e+01	-0.585	0.5585
## Countywood	-1.884e+01	5.141e+01	-0.366	0.7140
## Countywyandotte	-2.241e+01	5.147e+01	-0.435	0.6632
## Countyyavapai	-2.116e+01	5.146e+01	-0.411	0.6810
## Countyyolo	-2.419e+01	5.143e+01	-0.470	0.6380
## Countyyork	-1.641e+01	5.143e+01	-0.319	0.7497
## Countyyuma	-2.313e+01	5.151e+01	-0.449	0.6533
## Nitrous.Oxide	-2.977e+04	6.055e+04	-0.492	0.6230
## NF3	-2.977e+04	6.055e+04	-0.492	0.6230
## Other.GHG	-2.979e+04	6.055e+04	-0.492	0.6227
## Total.Emissions	2.977e+04	6.055e+04	0.492	0.6230
## HFC	-2.977e+04	6.055e+04	-0.492	0.6230
## Other.Fluorane	-2.977e+04	6.055e+04	-0.492	0.6230
## Biogenic.CO2	-7.465e-07	5.288e-07	-1.412	0.1581
## Population	9.773e-06	7.525e-07	12.988	< 2e-16 ***
## CO2	-2.977e+04	6.055e+04	-0.492	0.6230
## PFC	-2.977e+04	6.055e+04	-0.492	0.6230
## HFE	-2.977e+04	6.055e+04	-0.492	0.6230
## Stationary.Combustion	1.228e-07	1.142e-07	1.075	0.2822
## pp_consumed_MMBtu	-1.388e-07	1.197e-07	-1.159	0.2464
## Temperature	5.968e-01	6.472e-03	92.205	< 2e-16 ***
## Methane	-2.977e+04	6.055e+04	-0.492	0.6230
## SF6	-2.977e+04	6.055e+04	-0.492	0.6230
## Short.Lived.Compounds	-2.977e+04	6.055e+04	-0.492	0.6230

```

## Income           3.626e-05  1.849e-05   1.961   0.0498 *
## pp_net_gen_MWh -4.232e-07  1.169e-06  -0.362   0.7173
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 15.37 on 80655 degrees of freedom
## Multiple R-squared:  0.3215, Adjusted R-squared:  0.3186
## F-statistic: 110.4 on 346 and 80655 DF,  p-value: < 2.2e-16
step.mod = regsubsets(AQI ~ ., data = data_ozone, really.big = T, method='forward')

## Warning in leaps.setup(x, y, wt = wt, nbest = nbest, nvmax = nvmax,
## force.in = force.in, : 97 linear dependencies found

## Reordering variables and trying again:

Remove predictors based on R2 value-
ozone2.lmod <- lm(formula = AQI ~ Biogenic.CO2 + Population + Stationary.Combustion + pp_consumed_MMBtu
summary(ozone2.lmod)

##
## Call:
## lm(formula = AQI ~ Biogenic.CO2 + Population + Stationary.Combustion +
##     pp_consumed_MMBtu + Temperature + Income + pp_net_gen_MWh,
##     data = data_ozone)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -55.578  -9.949  -2.503   4.848 182.313
##
## Coefficients:
##                               Estimate Std. Error t value Pr(>|t|)
## (Intercept)            3.492e+01  3.023e-01 115.510 < 2e-16 ***
## Biogenic.CO2          -3.530e-06  2.047e-07 -17.244 < 2e-16 ***
## Population            6.131e-06  1.055e-07  58.125 < 2e-16 ***
## Stationary.Combustion -1.213e-07  3.604e-08  -3.365 0.000766 ***
## pp_consumed_MMBtu     2.773e-07  6.072e-08   4.567 4.96e-06 ***
## Temperature           4.598e-01  5.876e-03  78.248 < 2e-16 ***
## Income                -5.109e-05  5.920e-06  -8.630 < 2e-16 ***
## pp_net_gen_MWh        -2.898e-06  5.702e-07  -5.083 3.72e-07 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 17.36 on 80994 degrees of freedom
## Multiple R-squared:  0.1303, Adjusted R-squared:  0.1302
## F-statistic: 1733 on 7 and 80994 DF,  p-value: < 2.2e-16
ozone_geo2.lmod <- lm(formula = AQI ~ County + Biogenic.CO2 + Population + Stationary.Combustion + pp_consumed_MMBtu
summary(ozone_geo2.lmod)

##
## Call:
## lm(formula = AQI ~ County + Biogenic.CO2 + Population + Stationary.Combustion +
##     pp_consumed_MMBtu + Temperature + Income + pp_net_gen_MWh,
##     data = data_ozone)
##

```

```

## Residuals:
##      Min     1Q Median     3Q    Max
## -60.011 -8.800 -1.788  5.358 170.898
##
## Coefficients:
##                               Estimate Std. Error t value Pr(>|t|)
## (Intercept)                2.732e+01  1.214e+00 22.504 < 2e-16 ***
## Countyadams                5.933e+00  1.249e+00  4.749 2.05e-06 ***
## Countyaiken                -2.356e+00  2.542e+00 -0.927 0.353989
## Countyalachua              -3.073e+00  1.394e+00 -2.204 0.027494 *
## Countyalameda              -2.061e+00  1.498e+00 -1.376 0.168832
## Countyalbany               1.707e+01  1.312e+00 13.008 < 2e-16 ***
## Countyallegheny             3.962e+00  1.673e+00  2.369 0.017854 *
## Countyanderson              -6.074e-02  1.192e+00 -0.051 0.959362
## Countyarapahoe              6.709e+00  1.246e+00  5.384 7.30e-08 ***
## Countyarmstrong              8.152e+00  3.771e+00  2.162 0.030637 *
## Countyaroostook             -1.495e+00  1.463e+00 -1.022 0.307018
## Countyascension              5.664e+00  2.467e+00 -2.296 0.021668 *
## Countyashland                3.595e-01  1.271e+00  0.283 0.777250
## Countybaltimore              8.833e+00  1.185e+00  7.452 9.30e-14 ***
## Countybarnstable              1.375e+00  1.305e+00  1.054 0.292106
## Countybay                   -2.448e-01  1.464e+00 -0.167 0.867242
## Countybeaver                 1.133e+01  1.511e+00  7.497 6.60e-14 ***
## Countybell                   -5.188e+00  1.244e+00 -4.171 3.04e-05 ***
## Countybenton                 -2.550e-01  1.671e+00 -0.153 0.878664
## Countyberkeley                2.461e+00  1.239e+00 -1.987 0.046962 *
## Countyberks                  5.125e+00  1.627e+00  3.149 0.001638 **
## Countybexar                  -1.326e+01  1.580e+00 -8.390 < 2e-16 ***
## Countybibb                  -1.848e-01  2.099e+00 -0.088 0.929832
## Countyblair                  3.469e+00  1.455e+00  2.384 0.017107 *
## Countyblount                 1.311e+00  1.468e+00  0.894 0.371535
## Countyboone                  1.168e-01  1.373e+00  0.085 0.932178
## Countyboulder                 2.005e+00  1.789e+00  1.121 0.262342
## Countybradford                8.055e-01  1.581e+00  0.509 0.610486
## Countybrazoria              -5.839e+00  1.364e+00 -4.280 1.87e-05 ***
## Countybrevard                 -5.550e+00  1.321e+00 -4.202 2.65e-05 ***
## Countybristol                 -2.708e-01  1.280e+00 -0.212 0.832451
## Countybroward                 -1.272e+01  1.689e+00 -7.530 5.13e-14 ***
## Countybrown                  -2.903e+00  1.565e+00 -1.856 0.063512 .
## Countybucks                  -1.478e+00  1.320e+00 -1.120 0.262778
## Countybutte                  1.226e+01  1.445e+00  8.488 < 2e-16 ***
## Countycabell                 -3.419e+00  2.095e+00 -1.632 0.102713
## Countycache                  6.324e+00  1.374e+00  4.602 4.19e-06 ***
## Countycaddo                  -9.479e+00  1.189e+00 -7.969 1.61e-15 ***
## Countycalcasieu              4.070e+00  1.519e+00  2.679 0.007384 **
## Countycalvert                 6.317e+00  1.480e+00  4.269 1.96e-05 ***
## Countycambria                3.844e+00  1.433e+00  2.682 0.007326 **
## Countycameron                 -9.506e+00  1.544e+00 -6.158 7.41e-10 ***
## Countycampbell                6.569e+00  1.409e+00  4.664 3.11e-06 ***
## Countycanadian                -2.329e+00  1.292e+00 -1.802 0.071538 .
## Countycarbon                  1.088e+01  1.135e+00  9.586 < 2e-16 ***
## Countycecil                  8.739e+00  1.454e+00  6.009 1.88e-09 ***
## Countycentre                 3.879e+00  1.341e+00  2.893 0.003816 **
## Countychampaign              1.217e+00  1.337e+00  0.910 0.362631

```

## Countycharles	5.311e+00	1.561e+00	3.402	0.000668	***
## Countycharleston	-2.925e+00	1.802e+00	-1.623	0.104595	
## Countychatham	-1.901e+00	1.964e+00	-0.968	0.333026	
## Countycherokee	-5.478e-02	3.424e+00	-0.016	0.987237	
## Countychester	4.769e+00	1.522e+00	3.133	0.001728	**
## Countychesterfield	-1.932e+00	1.490e+00	-1.297	0.194721	
## Countychittenden	1.623e+00	1.312e+00	1.238	0.215877	
## Countyclackamas	-6.279e+00	1.560e+00	-4.024	5.72e-05	***
## Countyclark	-5.028e+00	1.164e+00	-4.322	1.55e-05	***
## Countyclarke	-3.850e-01	1.875e+00	-0.205	0.837336	
## Countyclearfield	-1.214e+00	1.525e+00	-0.796	0.426027	
## Countycleveland	-1.192e+00	1.358e+00	-0.877	0.380327	
## Countyclinton	2.644e+00	2.075e+00	1.274	0.202561	
## Countycobb	4.259e+00	1.814e+00	2.348	0.018901	*
## Countycochise	3.978e+00	1.288e+00	3.088	0.002015	**
## Countycoconino	1.044e+01	1.277e+00	8.174	3.02e-16	***
## Countycolbert	-2.972e+00	1.413e+00	-2.103	0.035455	*
## Countycollier	-6.403e+00	1.522e+00	-4.207	2.59e-05	***
## Countycollin	-9.477e+00	1.263e+00	-7.507	6.13e-14	***
## Countycolumbia	-4.047e+00	1.149e+00	-3.523	0.000427	***
## Countycolusa	2.498e+00	1.370e+00	1.823	0.068320	.
## Countycomanche	-1.371e+00	1.325e+00	-1.034	0.300939	
## Countycontracosta	-8.803e+00	1.560e+00	-5.642	1.69e-08	***
## Countyconverse	8.131e+00	1.306e+00	6.227	4.77e-10	***
## Countycook	-2.161e+01	2.734e+00	-7.903	2.76e-15	***
## Countycoweta	4.870e+00	2.966e+00	1.642	0.100621	
## Countycumberland	-7.034e-01	1.358e+00	-0.518	0.604473	
## Countydallas	-1.790e+01	1.729e+00	-10.351	< 2e-16	***
## Countydane	-3.199e+00	1.558e+00	-2.054	0.040013	*
## Countydarlington	7.171e-01	1.464e+00	0.490	0.624271	
## Countydauphin	2.417e+00	1.550e+00	1.559	0.118996	
## Countydavidson	3.577e+00	1.708e+00	2.094	0.036279	*
## Countydaviess	8.937e+00	1.976e+00	4.523	6.09e-06	***
## Countydavis	6.167e+00	1.339e+00	4.606	4.10e-06	***
## Countydekalb	2.732e+00	1.207e+00	2.264	0.023607	*
## Countydewar	1.040e+01	1.914e+00	5.433	5.56e-08	***
## Countydenali	2.614e+00	1.223e+00	2.138	0.032541	*
## Countydenton	-2.241e+00	1.317e+00	-1.701	0.088892	.
## Countydenver	8.620e+00	1.759e+00	4.899	9.63e-07	***
## Countydodge	3.356e-01	1.331e+00	0.252	0.800930	
## Countydorchester	4.345e+00	1.341e+00	3.239	0.001198	**
## Countydouglas	1.389e+01	1.302e+00	10.665	< 2e-16	***
## Countyduchesne	1.405e+01	1.284e+00	10.943	< 2e-16	***
## Countydupage	-1.471e+00	1.517e+00	-0.969	0.332415	
## Countyduval	-4.340e+00	1.499e+00	-2.895	0.003794	**
## Countyeffingham	2.058e+01	4.552e+00	4.521	6.18e-06	***
## Countyelk	1.460e+00	1.652e+00	0.883	0.377074	
## Countyelkhart	5.739e+00	1.607e+00	3.572	0.000355	***
## Countyellis	-1.148e+00	1.419e+00	-0.809	0.418433	
## Countyelmore	-6.790e-01	1.778e+00	-0.382	0.702565	
## Countyerie	3.651e+00	1.452e+00	2.515	0.011906	*
## Countyescambia	-1.279e-01	1.445e+00	-0.088	0.929499	
## Countyessex	-4.633e-01	1.367e+00	-0.339	0.734713	
## Countyetowah	6.696e+00	1.788e+00	3.745	0.000180	***

## Countyfairbanksnorthstar	-1.139e+01	1.346e+00	-8.467	< 2e-16	***
## Countyfairfax	-9.553e-01	1.632e+00	-0.585	0.558405	
## Countyfairfield	1.873e+01	1.831e+00	10.231	< 2e-16	***
## Countyfauquier	-4.091e+00	1.480e+00	-2.764	0.005712	**
## Countyfayette	4.728e-01	1.429e+00	0.331	0.740813	.
## Countyfloyd	6.708e+00	3.754e+00	1.787	0.073969	.
## Countyfranklin	-1.456e+00	1.138e+00	-1.280	0.200672	
## Countyfrederick	2.801e+00	1.444e+00	1.941	0.052306	.
## Countyfremont	1.096e+01	1.274e+00	8.602	< 2e-16	***
## Countyfresno	3.923e+01	1.442e+00	27.195	< 2e-16	***
## Countyfulton	1.045e+01	1.833e+00	5.701	1.19e-08	***
## Countygalveston	1.324e+00	1.340e+00	0.988	0.323297	
## Countygarfield	1.569e+01	1.269e+00	12.370	< 2e-16	***
## Countygarrett	6.720e+00	1.310e+00	5.130	2.90e-07	***
## Countygila	1.227e+01	1.960e+00	6.262	3.83e-10	***
## Countygiles	5.492e+00	1.391e+00	3.948	7.90e-05	***
## Countyglynn	-6.112e+00	2.029e+00	-3.012	0.002594	**
## Countygoshen	4.923e+00	1.343e+00	3.665	0.000248	***
## Countygreenup	6.420e+00	1.387e+00	4.629	3.68e-06	***
## Countygreenville	1.069e+00	1.426e+00	0.750	0.453366	
## Countygregg	-4.951e+00	1.251e+00	-3.959	7.54e-05	***
## Countygunnison	1.289e+01	1.268e+00	10.168	< 2e-16	***
## Countygwinnett	-1.130e+00	1.467e+00	-0.770	0.441190	
## Countyhamilton	6.208e+00	1.348e+00	4.607	4.10e-06	***
## Countyhampden	1.393e+00	1.344e+00	1.036	0.300129	
## Countyhancock	4.994e+00	1.171e+00	4.265	2.00e-05	***
## Countyhanover	-1.269e-01	1.485e+00	-0.085	0.931941	
## Countyhardin	1.029e+01	1.795e+00	5.730	1.01e-08	***
## Countyharford	1.004e+01	1.457e+00	6.891	5.58e-12	***
## Countyharris	-2.384e+01	2.830e+00	-8.425	< 2e-16	***
## Countyharrison	-2.589e+00	1.398e+00	-1.852	0.064029	.
## Countyhartford	3.501e+00	1.577e+00	2.220	0.026408	*
## Countyhenderson	7.766e+00	1.854e+00	4.189	2.80e-05	***
## Countyhendricks	3.280e+00	2.394e+00	1.370	0.170643	
## Countyhenrico	-3.907e-01	1.392e+00	-0.281	0.778992	
## Countyhidalgo	-1.892e+01	1.564e+00	-12.097	< 2e-16	***
## Countyhillsborough	-1.465e+00	1.586e+00	-0.924	0.355657	
## Countyhonolulu	-1.307e+01	1.407e+00	-9.289	< 2e-16	***
## Countyhood	-4.469e+00	1.255e+00	-3.562	0.000369	***
## Countyhorry	-1.628e+01	1.637e+00	-9.944	< 2e-16	***
## Countyhouston	-5.727e+00	1.427e+00	-4.013	5.99e-05	***
## Countyhumboldt	-3.078e+00	1.392e+00	-2.212	0.026956	*
## Countyhunt	-6.020e+00	1.255e+00	-4.799	1.60e-06	***
## Countyiberville	2.906e+01	1.266e+00	22.951	< 2e-16	***
## Countyimperial	1.845e+01	1.609e+00	11.465	< 2e-16	***
## Countyindiana	9.588e+00	1.768e+00	5.422	5.90e-08	***
## Countyjackson	-6.906e+00	1.733e+00	-3.984	6.79e-05	***
## Countyjefferson	4.217e+00	1.040e+00	4.055	5.01e-05	***
## Countyjohnson	-3.302e+00	1.119e+00	-2.949	0.003185	**
## Countykanawha	7.255e-01	1.543e+00	0.470	0.638229	
## Countykane	-1.958e+00	1.303e+00	-1.503	0.132946	
## Countykaufman	-3.620e+00	1.377e+00	-2.629	0.008558	**
## Countykay	6.266e-01	1.642e+00	0.382	0.702727	
## Countykennebec	-1.180e+00	1.431e+00	-0.824	0.409899	

## Countykenosha	1.180e+01	1.458e+00	8.096	5.76e-16	***
## Countykent	3.799e+00	1.309e+00	2.902	0.003710	**
## Countykern	4.095e+01	1.590e+00	25.756	< 2e-16	***
## Countyking	-1.624e+01	1.871e+00	-8.680	< 2e-16	***
## Countykings	3.044e+01	1.486e+00	20.487	< 2e-16	***
## Countyknox	1.728e+00	1.109e+00	1.559	0.119037	
## Countylackawanna	5.185e+00	1.369e+00	3.788	0.000152	***
## Countylafayette	-5.421e+00	1.406e+00	-3.855	0.000116	***
## Countylake	-3.273e+00	1.049e+00	-3.121	0.001802	**
## Countylancaster	5.632e+00	1.590e+00	3.542	0.000398	***
## Countylane	-7.312e+00	1.619e+00	-4.518	6.26e-06	***
## Countylapaz	4.997e+00	1.324e+00	3.773	0.000161	***
## Countylaporte	9.534e-01	1.525e+00	0.625	0.531886	
## Countylaramie	9.992e+00	1.273e+00	7.850	4.21e-15	***
## Countylarimer	2.109e+01	1.282e+00	16.449	< 2e-16	***
## Countylawrence	-1.779e+00	1.453e+00	-1.224	0.220865	
## Countylebanon	9.254e+00	1.764e+00	5.245	1.56e-07	***
## Countylee	-6.658e+00	1.542e+00	-4.318	1.58e-05	***
## Countylehigh	1.779e+00	1.546e+00	1.151	0.249879	
## Countyleon	-7.379e+00	1.863e+00	-3.961	7.47e-05	***
## Countylinn	3.897e+00	1.726e+00	2.258	0.023978	*
## Countylitchfield	7.679e+00	1.295e+00	5.928	3.08e-09	***
## Countylorain	2.028e-01	1.504e+00	0.135	0.892704	
## Countylosangeles	-2.359e+01	4.831e+00	-4.883	1.05e-06	***
## Countylucas	3.652e+00	1.482e+00	2.465	0.013709	*
## Countyluzerne	2.518e+00	1.307e+00	1.927	0.054017	.
## Countylycoming	1.437e+00	1.259e+00	1.142	0.253472	
## Countymacon	-1.337e+00	2.748e+00	-0.487	0.626581	
## Countymadera	2.791e+01	1.413e+00	19.760	< 2e-16	***
## Countymadison	4.233e+00	1.319e+00	3.209	0.001331	**
## Countymahoning	-5.494e+00	2.080e+00	-2.641	0.008260	**
## Countymanatee	-7.788e+00	1.300e+00	-5.990	2.11e-09	***
## Countymanitowoc	6.317e+00	1.544e+00	4.092	4.28e-05	***
## Countymarathon	-1.046e+00	1.486e+00	-0.704	0.481475	
## Countymaricopa	-2.326e+00	2.609e+00	-0.891	0.372700	
## Countymarin	-1.099e+01	2.019e+00	-5.443	5.25e-08	***
## Countymarion	-2.019e+00	1.166e+00	-1.731	0.083420	.
## Countymartin	-1.771e+00	1.579e+00	-1.122	0.261914	
## Countymatanuskasusitna	-6.371e+00	1.174e+00	-5.428	5.72e-08	***
## Countymayes	-9.632e-01	1.327e+00	-0.726	0.468053	
## Countymcclain	-1.517e+00	1.278e+00	-1.187	0.235310	
## Countymccracken	1.433e+00	2.289e+00	0.626	0.531333	
## Countymchenry	1.009e+00	1.473e+00	0.685	0.493313	
## Countymclean	9.611e-01	1.304e+00	0.737	0.461027	
## Countymclennan	-7.490e+00	1.278e+00	-5.858	4.69e-09	***
## Countymerced	1.583e+01	1.399e+00	11.318	< 2e-16	***
## Countymercier	6.361e+00	1.406e+00	4.526	6.03e-06	***
## Countymesa	7.792e+00	1.301e+00	5.990	2.11e-09	***
## Countymiamidade	-6.534e+00	2.727e+00	-2.397	0.016554	*
## Countymiddlesex	1.548e+01	1.566e+00	9.884	< 2e-16	***
## Countymilwaukee	8.856e-01	1.466e+00	0.604	0.545793	
## Countymobile	-2.376e+00	1.876e+00	-1.267	0.205317	
## Countymoffat	7.538e+00	1.276e+00	5.907	3.49e-09	***
## Countymonganlia	-1.232e+00	1.477e+00	-0.834	0.404152	

## Countymonroe	3.325e+00	1.491e+00	2.230	0.025771	*
## Countymonterey	-6.168e+00	1.342e+00	-4.598	4.27e-06	***
## Countymontezuma	1.343e+01	1.252e+00	10.722	< 2e-16	***
## Countymontgomery	-1.410e+00	1.114e+00	-1.266	0.205645	
## Countymontrose	4.875e+00	1.365e+00	3.572	0.000354	***
## Countymorgan	2.457e+00	1.432e+00	1.716	0.086200	.
## Countymultnomah	-1.308e+01	1.357e+00	-9.640	< 2e-16	***
## Countymurray	4.220e+00	1.401e+00	3.012	0.002594	**
## Countymuscogee	-6.060e+00	1.841e+00	-3.292	0.000996	***
## Countynapa	-5.980e+00	1.574e+00	-3.800	0.000145	***
## Countynatrona	6.769e+00	1.344e+00	5.035	4.78e-07	***
## Countynavajo	5.579e+00	1.282e+00	4.351	1.35e-05	***
## Countyneosho	-5.331e+00	1.752e+00	-3.042	0.002348	**
## Countynorthhampton	9.188e+00	1.548e+00	5.936	2.94e-09	***
## Countynueces	-1.045e+01	1.386e+00	-7.537	4.85e-14	***
## Countyoklahoma	-1.386e+00	1.385e+00	-1.000	0.317129	
## Countyoldham	1.549e+00	2.388e+00	0.649	0.516562	
## Countyorange	-7.240e+00	1.215e+00	-5.958	2.56e-09	***
## Countyosage	-1.096e+00	1.462e+00	-0.749	0.453569	
## Countyosceola	-6.815e+00	1.271e+00	-5.360	8.36e-08	***
## Countyouachita	-6.083e+00	1.242e+00	-4.897	9.74e-07	***
## Countyoutagamie	-3.514e+00	1.742e+00	-2.017	0.043663	*
## Countyoxford	-4.259e+00	1.582e+00	-2.693	0.007089	**
## Countyozaukee	5.457e+00	1.625e+00	3.358	0.000785	***
## Countyparker	-3.532e+00	1.247e+00	-2.832	0.004631	**
## Countypasco	-5.760e+00	1.282e+00	-4.494	7.00e-06	***
## Countypenobscot	-1.197e+00	1.460e+00	-0.820	0.412489	
## Countypeoria	2.633e+00	1.499e+00	1.757	0.078906	.
## Countyperry	3.618e+00	1.500e+00	2.412	0.015887	*
## Countyphiladelphia	3.072e+00	1.640e+00	1.873	0.061025	.
## Countypickens	-1.744e+00	2.164e+00	-0.806	0.420219	
## Countypierce	-1.721e+00	1.452e+00	-1.186	0.235682	
## Countypima	-5.151e-01	1.405e+00	-0.367	0.713875	
## Countypinal	1.555e+01	1.777e+00	8.747	< 2e-16	***
## Countypinellas	-5.406e+00	1.442e+00	-3.749	0.000177	***
## Countypittsburg	-2.099e+00	1.612e+00	-1.302	0.192919	
## Countyplacer	2.003e+01	1.326e+00	15.103	< 2e-16	***
## Countypolk	-3.165e+00	1.320e+00	-2.397	0.016539	*
## Countyporter	6.932e+00	1.606e+00	4.316	1.59e-05	***
## Countyposey	1.183e+00	1.498e+00	0.790	0.429574	
## Countyprovidence	1.791e+00	1.518e+00	1.179	0.238323	
## Countypulaski	7.578e-01	1.234e+00	0.614	0.539139	
## Countyracine	6.144e+00	1.480e+00	4.151	3.32e-05	***
## Countyrandolph	3.777e+00	2.351e+00	1.606	0.108187	
## Countyrichland	1.569e+00	1.588e+00	0.988	0.323135	
## Countyrichmond	-1.450e+00	1.722e+00	-0.842	0.399979	
## Countyriverside	3.900e+01	1.738e+00	22.439	< 2e-16	***
## Countyroanoke	1.376e+00	1.535e+00	0.897	0.369884	
## Countyrock	-1.035e+00	3.348e+00	-0.309	0.757258	
## Countyrockdale	5.399e+00	1.580e+00	3.417	0.000633	***
## Countyrockingham	-6.552e-01	1.453e+00	-0.451	0.652130	
## Countyrussell	3.577e+00	1.797e+00	1.991	0.046530	*
## Countyrutland	-6.262e-01	1.445e+00	-0.433	0.664799	
## Countysacramento	5.743e+00	1.295e+00	4.436	9.20e-06	***

## Countysangamon	-1.661e+00	1.358e+00	-1.223	0.221400	
## Countysarasota	-3.529e+00	1.417e+00	-2.490	0.012759	*
## Countysauk	-1.684e+00	1.495e+00	-1.127	0.259953	
## Countyscott	4.782e+00	2.059e+00	2.322	0.020231	*
## Countysedgwick	-3.411e+00	1.328e+00	-2.567	0.010249	*
## Countyseminole	-7.699e+00	1.318e+00	-5.843	5.15e-09	***
## Countysequoyah	-3.182e+00	1.399e+00	-2.275	0.022931	*
## Countyshasta	7.279e+00	1.249e+00	5.826	5.71e-09	***
## Countyshawnee	-4.085e+00	1.386e+00	-2.948	0.003202	**
## Countysheboygan	7.321e+00	1.441e+00	5.080	3.78e-07	***
## Countyshelby	-2.497e-01	1.173e+00	-0.213	0.831450	
## Countysheridan	5.337e+00	1.318e+00	4.050	5.12e-05	***
## Countyskagit	-2.024e+00	1.352e+00	-1.496	0.134535	
## Countysolano	-5.261e+00	1.423e+00	-3.698	0.000217	***
## Countysomerset	1.968e+00	1.326e+00	1.485	0.137591	
## Countysonoma	-1.019e+01	1.306e+00	-7.802	6.15e-15	***
## Countyspartanburg	6.031e+00	1.623e+00	3.715	0.000203	***
## Countyspokane	-5.495e+00	1.652e+00	-3.326	0.000881	***
## Countystafford	-2.284e+00	2.176e+00	-1.050	0.293835	
## Countystanislaus	1.517e+01	1.440e+00	10.534	< 2e-16	***
## Countystory	-4.150e+00	1.422e+00	-2.918	0.003524	**
## Countysullivan	2.062e+00	1.863e+00	1.107	0.268481	
## Countysussex	5.016e+00	1.295e+00	3.874	0.000107	***
## Countysutter	2.130e+01	1.438e+00	14.813	< 2e-16	***
## Countysweetwater	1.052e+01	1.328e+00	7.921	2.39e-15	***
## Countytarrant	-1.110e+01	1.571e+00	-7.066	1.61e-12	***
## Countytehama	1.697e+01	1.280e+00	13.257	< 2e-16	***
## Countytiooga	5.017e+00	1.296e+00	3.872	0.000108	***
## Countytolland	4.699e+00	1.513e+00	3.106	0.001896	**
## Countytooele	7.802e+00	1.335e+00	5.844	5.12e-09	***
## Countytravis	-9.011e+00	1.427e+00	-6.314	2.73e-10	***
## Countytucker	4.471e+00	1.273e+00	3.511	0.000447	***
## Countytulare	5.012e+01	1.405e+00	35.681	< 2e-16	***
## Countytulsa	-2.661e-01	1.455e+00	-0.183	0.854866	
## Countytuscaloosa	3.881e-01	1.859e+00	0.209	0.834635	
## Countyuinta	8.915e+00	1.256e+00	7.096	1.29e-12	***
## Countyuintah	1.763e+01	1.281e+00	13.756	< 2e-16	***
## Countyumatilla	-6.416e-02	1.641e+00	-0.039	0.968810	
## Countyutah	1.052e+01	1.414e+00	7.438	1.04e-13	***
## Countyvanderburgh	3.762e+00	1.433e+00	2.626	0.008645	**
## Countyventura	7.699e+00	1.391e+00	5.536	3.11e-08	***
## Countyvictoria	-9.024e+00	1.260e+00	-7.161	8.06e-13	***
## Countyvigo	-1.219e+00	2.287e+00	-0.533	0.593974	
## Countyvolusia	-4.945e+00	1.373e+00	-3.602	0.000316	***
## Countywabash	1.607e+00	1.322e+00	1.216	0.224029	
## Countywakulla	-3.132e+00	1.404e+00	-2.230	0.025745	*
## Countywarren	-3.884e+00	2.284e+00	-1.700	0.089132	.
## Countywarrick	6.032e+00	1.519e+00	3.970	7.19e-05	***
## Countywasco	-4.164e+00	1.573e+00	-2.647	0.008123	**
## Countywashington	1.294e+00	1.020e+00	1.269	0.204369	
## Countywebb	-1.245e+01	1.753e+00	-7.105	1.21e-12	***
## Countyweber	1.233e+01	1.360e+00	9.072	< 2e-16	***
## Countyweld	1.018e+01	1.332e+00	7.638	2.24e-14	***
## Countywestmoreland	7.881e+00	1.569e+00	5.022	5.12e-07	***

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## Countywhatcom      -1.029e+01  1.595e+00  -6.452 1.11e-10 ***
## Countywill        1.175e+00  1.525e+00   0.771 0.440747
## Countywindham     2.546e+00  1.257e+00   2.025 0.042905 *
## Countywinnebago   -8.555e+00  1.582e+00  -5.406 6.45e-08 ***
## Countywood         2.283e+00  1.258e+00   1.815 0.069525 .
## Countywyandotte  -1.536e+00  1.660e+00  -0.925 0.355013
## Countyyavapai     2.153e-01  1.265e+00   0.170 0.864801
## Countyyolo         -2.555e+00  1.320e+00  -1.936 0.052866 .
## Countyyork         4.870e+00  1.173e+00   4.153 3.28e-05 ***
## Countyyuma         -1.856e+00  1.428e+00  -1.300 0.193661
## Biogenic.CO2       -1.115e-06  4.700e-07  -2.372 0.017699 *
## Population         8.726e-06  4.712e-07  18.518 < 2e-16 ***
## Stationary.Combustion 2.456e-07  6.285e-08  3.908 9.32e-05 ***
## pp_consumed_MMBtu -1.784e-07  1.169e-07  -1.526 0.127117
## Temperature        5.916e-01  6.460e-03  91.586 < 2e-16 ***
## Income              1.639e-06  1.755e-05   0.093 0.925614
## pp_net_gen_MWh    4.074e-07  1.138e-06   0.358 0.720391
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 15.4 on 80667 degrees of freedom
## Multiple R-squared:  0.3189, Adjusted R-squared:  0.3161
## F-statistic: 113.1 on 334 and 80667 DF, p-value: < 2.2e-16

```

Defining Parameter = PM.25

```

pm25.lmod <- lm(formula = AQI ~ Nitrous.Oxide + NF3 + Other.GHG + Total.Emissions + HFC +
Other.Fluorane + Biogenic.CO2 + Population + CO2 + PFC + HFE + Stationary.Combustion + pp_consumed_MMBtu

summary(pm25.lmod)

##
## Call:
## lm(formula = AQI ~ Nitrous.Oxide + NF3 + Other.GHG + Total.Emissions +
##     HFC + Other.Fluorane + Biogenic.CO2 + Population + CO2 +
##     PFC + HFE + Stationary.Combustion + pp_consumed_MMBtu + Temperature +
##     Methane + SF6 + Short.Lived.Compounds + Income + pp_net_gen_MWh,
##     data = data_PM25)
##
## Residuals:
##      Min      1Q      Median      3Q      Max
## -47.330 -13.437  -1.484   11.809  177.838
##
## Coefficients:
##                               Estimate Std. Error t value Pr(>|t|)
## (Intercept)               3.708e+01  4.272e-01  86.796 < 2e-16 ***
## Nitrous.Oxide            -8.476e+04  8.545e+04  -0.992 0.321258
## NF3                      -8.476e+04  8.545e+04  -0.992 0.321258
## Other.GHG                -8.476e+04  8.545e+04  -0.992 0.321258
## Total.Emissions           8.476e+04  8.545e+04   0.992 0.321258
## HFC                      -8.476e+04  8.545e+04  -0.992 0.321258
## Other.Fluorane            -8.476e+04  8.545e+04  -0.992 0.321258
## Biogenic.CO2              -3.217e-06  2.160e-07 -14.889 < 2e-16 ***

```

```

## Population          4.972e-06  1.312e-07  37.900 < 2e-16 ***
## CO2                -8.476e+04  8.545e+04  -0.992 0.321258
## PFC                -8.476e+04  8.545e+04  -0.992 0.321258
## HFE                -8.476e+04  8.545e+04  -0.992 0.321258
## Stationary.Combustion -5.978e-08  6.919e-08  -0.864 0.387628
## pp_consumed_MMBtu   2.906e-07  7.504e-08   3.872 0.000108 ***
## Temperature         -3.924e-02  7.705e-03  -5.093 3.54e-07 ***
## Methane              -8.476e+04  8.545e+04  -0.992 0.321258
## SF6                 -8.476e+04  8.545e+04  -0.992 0.321258
## Short.Lived.Compounds -8.476e+04  8.545e+04  -0.992 0.321261
## Income               1.136e-05  8.479e-06   1.340 0.180190
## pp_net_gen_MWh      -3.091e-06  7.051e-07  -4.384 1.17e-05 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 19.01 on 50283 degrees of freedom
## Multiple R-squared:  0.06214,    Adjusted R-squared:  0.06178
## F-statistic: 175.3 on 19 and 50283 DF,  p-value: < 2.2e-16

pm25_geo.lmod <- lm(formula = AQI ~ County + Nitrous.Oxide + NF3 + Other.GHG + Total.Emissions + HFC +
Other.Fluorane + Biogenic.CO2 + Population + CO2 + PFC + HFE + Stationary.Combustion + pp_consumed_MMBtu)

summary(pm25_geo.lmod)

##
## Call:
## lm(formula = AQI ~ County + Nitrous.Oxide + NF3 + Other.GHG +
##     Total.Emissions + HFC + Other.Fluorane + Biogenic.CO2 + Population +
##     CO2 + PFC + HFE + Stationary.Combustion + pp_consumed_MMBtu +
##     Temperature + Methane + SF6 + Short.Lived.Compounds + Income +
##     pp_net_gen_MWh, data = data_PM25)
##
## Residuals:
##       Min     1Q     Median      3Q     Max 
## -64.635 -10.090  -1.600    8.241 173.053 
##
## Coefficients: (1 not defined because of singularities)
##             Estimate Std. Error t value Pr(>|t|)    
## (Intercept) -7.025e+01  1.275e+01 -5.509 3.62e-08 ***
## Countyadams  9.152e+01  1.305e+01  7.014 2.35e-12 ***
## Countyalachua 1.017e+02  1.299e+01  7.832 4.91e-15 ***
## Countyalameda 9.379e+01  1.223e+01  7.670 1.75e-14 ***
## Countyalbany  1.007e+02  1.514e+01  6.655 2.87e-11 ***
## Countyaleutianseast 8.120e+01  1.331e+01  6.102 1.06e-09 ***
## Countyallegheny 1.042e+02  1.248e+01  8.350 < 2e-16 ***
## Countyanchorage 9.694e+01  1.305e+01  7.427 1.13e-13 ***
## Countyapache  7.360e+01  1.355e+01  5.431 5.63e-08 ***
## Countyarapahoe 1.088e+02  1.420e+01  7.660 1.89e-14 ***
## Countyarkansas 1.047e+02  1.315e+01  7.959 1.77e-15 ***
## Countyarmstrong 1.153e+02  1.408e+01  8.192 2.64e-16 ***
## Countyaroostook 1.102e+02  1.303e+01  8.455 < 2e-16 ***
## Countyashland  1.029e+02  1.375e+01  7.481 7.52e-14 ***
## Countyashley   1.085e+02  1.309e+01  8.286 < 2e-16 ***
## Countybaker    9.529e+01  1.304e+01  7.308 2.76e-13 ***
## Countybaltimore 1.057e+02  1.267e+01  8.347 < 2e-16 ***

```

## Countybannock	7.959e+01	1.009e+01	7.889	3.11e-15	***
## Countybarnstable	1.036e+02	1.411e+01	7.342	2.14e-13	***
## Countybay	1.109e+02	1.313e+01	8.446	< 2e-16	***
## Countybeaver	1.092e+02	1.335e+01	8.185	2.80e-16	***
## Countybenton	9.009e+01	1.304e+01	6.911	4.88e-12	***
## Countyberkeley	1.070e+02	1.311e+01	8.163	3.33e-16	***
## Countyberks	1.135e+02	1.291e+01	8.790	< 2e-16	***
## Countyberkshire	9.731e+01	1.310e+01	7.431	1.10e-13	***
## Countybexar	8.435e+01	1.275e+01	6.614	3.77e-11	***
## Countybibb	1.137e+02	1.306e+01	8.705	< 2e-16	***
## Countyblair	1.127e+02	1.303e+01	8.648	< 2e-16	***
## Countyblount	1.366e+02	1.375e+01	9.933	< 2e-16	***
## Countybonner	9.579e+01	1.302e+01	7.357	1.90e-13	***
## Countybonneville	9.693e+01	1.302e+01	7.442	1.01e-13	***
## Countyboulder	9.751e+01	1.318e+01	7.399	1.39e-13	***
## Countybradford	1.141e+02	1.309e+01	8.717	< 2e-16	***
## Countybrevard	7.849e+01	1.066e+01	7.363	1.82e-13	***
## Countybristol	1.007e+02	1.301e+01	7.745	9.74e-15	***
## Countybroward	8.435e+01	1.211e+01	6.966	3.29e-12	***
## Countybrown	9.725e+01	1.297e+01	7.498	6.59e-14	***
## Countybutte	1.257e+02	1.297e+01	9.694	< 2e-16	***
## Countycabell	1.053e+02	1.336e+01	7.881	3.32e-15	***
## Countycache	1.228e+02	1.298e+01	9.460	< 2e-16	***
## Countycaddo	1.137e+02	1.305e+01	8.709	< 2e-16	***
## Countycalcasieu	1.047e+02	1.312e+01	7.979	1.50e-15	***
## Countycambria	1.151e+02	1.305e+01	8.819	< 2e-16	***
## Countycameron	1.127e+02	1.270e+01	8.878	< 2e-16	***
## Countycampbell	1.117e+02	1.376e+01	8.121	4.73e-16	***
## Countycanyon	1.081e+02	1.282e+01	8.434	< 2e-16	***
## Countycarbon	1.243e+02	1.707e+01	7.283	3.30e-13	***
## Countycecil	1.083e+02	1.307e+01	8.289	< 2e-16	***
## Countycentre	1.151e+02	1.304e+01	8.826	< 2e-16	***
## Countychampaign	1.091e+02	1.301e+01	8.388	< 2e-16	***
## Countycharleston	1.108e+02	1.303e+01	8.506	< 2e-16	***
## Countychatham	1.146e+02	1.309e+01	8.758	< 2e-16	***
## Countychelan	9.437e+01	1.313e+01	7.189	6.61e-13	***
## Countychester	1.125e+02	1.306e+01	8.616	< 2e-16	***
## Countychesterfield	9.378e+01	1.321e+01	7.102	1.25e-12	***
## Countychittenden	1.345e+02	1.998e+01	6.734	1.67e-11	***
## Countycitrus	9.812e+01	1.314e+01	7.469	8.21e-14	***
## Countyclackamas	6.898e+01	1.301e+01	5.301	1.15e-07	***
## Countyclark	1.105e+02	1.323e+01	8.353	< 2e-16	***
## Countyclarke	1.098e+02	1.298e+01	8.458	< 2e-16	***
## Countycleveland	1.103e+02	1.298e+01	8.499	< 2e-16	***
## Countyclinton	1.197e+02	1.305e+01	9.170	< 2e-16	***
## Countycobb	9.838e+01	1.311e+01	7.505	6.25e-14	***
## Countycochise	8.721e+01	1.618e+01	5.389	7.13e-08	***
## Countycoconino	1.121e+02	1.598e+01	7.011	2.40e-12	***
## Countycolbert	1.020e+02	1.339e+01	7.617	2.64e-14	***
## Countycoller	1.033e+02	1.329e+01	7.772	7.90e-15	***
## Countycolumbia	9.145e+01	1.310e+01	6.979	3.02e-12	***
## Countycolusa	1.169e+02	1.322e+01	8.841	< 2e-16	***
## Countycomanche	1.116e+02	1.306e+01	8.545	< 2e-16	***
## Countycontracosta	8.897e+01	1.290e+01	6.895	5.46e-12	***

## Countyconverse	1.213e+02	1.495e+01	8.113	5.05e-16	***
## Countycook	3.994e+01	1.034e+01	3.863	0.000112	***
## Countycoweta	9.195e+01	1.319e+01	6.969	3.23e-12	***
## Countycowlitz	9.672e+01	1.323e+01	7.309	2.73e-13	***
## Countycumberland	1.060e+02	1.278e+01	8.296	< 2e-16	***
## Countydallas	2.940e+02	2.993e+01	9.823	< 2e-16	***
## Countydane	9.908e+01	1.286e+01	7.706	1.32e-14	***
## Countydauphin	1.157e+02	1.303e+01	8.886	< 2e-16	***
## Countydavidson	1.055e+02	1.277e+01	8.256	< 2e-16	***
## Countydaviess	1.132e+02	1.303e+01	8.689	< 2e-16	***
## Countydavis	1.196e+02	1.293e+01	9.254	< 2e-16	***
## Countydekalb	1.122e+02	1.262e+01	8.888	< 2e-16	***
## Countydelaware	1.078e+02	1.304e+01	8.269	< 2e-16	***
## Countydenali	8.932e+01	1.440e+01	6.202	5.63e-10	***
## Countydenton	9.960e+01	1.268e+01	7.855	4.09e-15	***
## Countydenver	1.186e+02	1.296e+01	9.152	< 2e-16	***
## Countydeschutes	9.018e+01	1.301e+01	6.933	4.18e-12	***
## Countydodge	1.138e+02	1.308e+01	8.700	< 2e-16	***
## Countydorchester	1.142e+02	1.313e+01	8.695	< 2e-16	***
## Countydougherty	1.057e+02	1.297e+01	8.147	3.83e-16	***
## Countydouglas	9.152e+01	1.298e+01	7.050	1.82e-12	***
## Countydubois	1.073e+02	1.324e+01	8.104	5.44e-16	***
## Countyduchesne	1.225e+02	1.329e+01	9.218	< 2e-16	***
## Countydupage	8.951e+01	1.278e+01	7.004	2.52e-12	***
## Countyduval	9.518e+01	1.281e+01	7.430	1.10e-13	***
## Countyector	9.699e+01	1.303e+01	7.442	1.01e-13	***
## Countyelkhart	1.074e+02	1.295e+01	8.292	< 2e-16	***
## Countyellis	1.090e+02	1.312e+01	8.306	< 2e-16	***
## Countyerie	1.116e+02	1.293e+01	8.636	< 2e-16	***
## Countyescambia	1.167e+02	7.752e+01	1.506	0.132135	
## Countyessex	1.029e+02	1.289e+01	7.982	1.47e-15	***
## Countyetowah	1.238e+02	1.297e+01	9.551	< 2e-16	***
## Countyfairbanksnorthstar	1.447e+02	1.312e+01	11.032	< 2e-16	***
## Countyfairfax	9.057e+01	1.266e+01	7.156	8.44e-13	***
## Countyfairfield	9.752e+01	1.319e+01	7.393	1.46e-13	***
## Countyfayette	9.493e+01	1.322e+01	7.179	7.12e-13	***
## Countyflorence	1.052e+02	1.304e+01	8.062	7.66e-16	***
## Countyfloyd	1.112e+02	1.305e+01	8.519	< 2e-16	***
## Countyfranklin	9.059e+01	1.299e+01	6.972	3.16e-12	***
## Countyfrederick	1.044e+02	1.318e+01	7.925	2.33e-15	***
## Countyfremont	1.262e+02	1.331e+01	9.480	< 2e-16	***
## Countyfresno	1.283e+02	1.246e+01	10.302	< 2e-16	***
## Countyfulton	1.041e+02	1.269e+01	8.204	2.38e-16	***
## Countygalveston	9.963e+01	1.316e+01	7.573	3.70e-14	***
## Countygarrett	1.056e+02	1.317e+01	8.021	1.07e-15	***
## Countyglynn	1.134e+02	1.322e+01	8.577	< 2e-16	***
## Countygoshen	1.145e+02	1.329e+01	8.615	< 2e-16	***
## Countygrant	8.496e+01	1.330e+01	6.388	1.70e-10	***
## Countygreenville	1.104e+02	1.278e+01	8.639	< 2e-16	***
## Countygwinnett	9.206e+01	1.247e+01	7.384	1.56e-13	***
## Countyhamilton	1.055e+02	1.309e+01	8.056	8.04e-16	***
## Countyhampden	1.071e+02	1.290e+01	8.306	< 2e-16	***
## Countyhancock	1.056e+02	1.332e+01	7.927	2.30e-15	***
## Countyhardin	1.117e+02	1.299e+01	8.596	< 2e-16	***

## Countyharford	1.033e+02	1.307e+01	7.909	2.65e-15	***
## Countyharris	1.196e+01	1.133e+01	1.055	0.291325	
## Countyharrison	1.014e+02	1.327e+01	7.640	2.21e-14	***
## Countyhartford	1.020e+02	1.268e+01	8.042	9.00e-16	***
## Countyhawaii	1.293e+02	1.359e+01	9.516	< 2e-16	***
## Countyhenderson	2.822e+02	3.567e+01	7.911	2.60e-15	***
## Countyhenrico	1.064e+02	1.306e+01	8.143	3.93e-16	***
## Countyhenry	9.996e+01	1.304e+01	7.667	1.79e-14	***
## Countyhidalgo	1.046e+02	1.248e+01	8.382	< 2e-16	***
## Countyhillsborough	8.588e+01	1.261e+01	6.809	9.92e-12	***
## Countyhonolulu	8.866e+01	1.271e+01	6.978	3.04e-12	***
## Countyhouston	1.012e+02	1.306e+01	7.747	9.59e-15	***
## Countyhoward	1.098e+02	1.323e+01	8.298	< 2e-16	***
## Countyhumboldt	1.129e+02	1.305e+01	8.650	< 2e-16	***
## Countyiberville	1.068e+02	1.351e+01	7.902	2.79e-15	***
## Countyimperial	1.309e+02	1.303e+01	10.050	< 2e-16	***
## Countyjackson	1.031e+02	1.294e+01	7.969	1.63e-15	***
## Countyjefferson	9.442e+01	1.306e+01	7.229	4.95e-13	***
## Countyjerome	8.385e+01	1.304e+01	6.430	1.29e-10	***
## Countyjohnson	1.028e+02	1.300e+01	7.907	2.70e-15	***
## Countyjuneau	9.584e+01	1.327e+01	7.222	5.21e-13	***
## Countykanawha	1.051e+02	1.297e+01	8.105	5.38e-16	***
## Countykane	1.068e+02	1.293e+01	8.258	< 2e-16	***
## Countykauai	8.567e+01	1.305e+01	6.564	5.28e-11	***
## Countykaufman	1.098e+02	1.316e+01	8.343	< 2e-16	***
## Countykay	1.152e+02	1.306e+01	8.822	< 2e-16	***
## Countykenaipeninsula	7.708e+01	1.314e+01	5.866	4.48e-09	***
## Countykennebec	9.884e+01	1.334e+01	7.409	1.29e-13	***
## Countykenosha	9.384e+01	1.317e+01	7.124	1.06e-12	***
## Countykent	1.118e+02	1.306e+01	8.560	< 2e-16	***
## Countykern	1.290e+02	1.284e+01	10.051	< 2e-16	***
## Countyking	8.030e+01	1.201e+01	6.685	2.33e-11	***
## Countykings	1.441e+02	1.295e+01	11.126	< 2e-16	***
## Countyklamath	1.025e+02	1.302e+01	7.872	3.55e-15	***
## Countyklickitat	8.687e+01	1.316e+01	6.599	4.18e-11	***
## Countyknox	1.103e+02	1.284e+01	8.585	< 2e-16	***
## Countykootenai	9.245e+01	1.297e+01	7.128	1.03e-12	***
## Countylackawanna	1.123e+02	1.298e+01	8.651	< 2e-16	***
## Countylafayette	1.153e+02	1.301e+01	8.866	< 2e-16	***
## Countylake	9.006e+01	1.309e+01	6.881	6.02e-12	***
## Countylancaster	1.172e+02	1.276e+01	9.178	< 2e-16	***
## Countylane	1.049e+02	1.284e+01	8.172	3.11e-16	***
## Countylapaz	9.862e+01	1.323e+01	7.455	9.11e-14	***
## Countylaporte	1.012e+02	1.311e+01	7.719	1.20e-14	***
## Countylaramie	1.055e+02	1.353e+01	7.799	6.36e-15	***
## Countylarimer	8.937e+01	9.689e+00	9.224	< 2e-16	***
## Countylawrence	9.962e+01	1.304e+01	7.642	2.18e-14	***
## Countylebanon	1.196e+02	1.309e+01	9.141	< 2e-16	***
## Countylee	9.860e+01	1.298e+01	7.598	3.05e-14	***
## Countylehigh	1.144e+02	1.292e+01	8.858	< 2e-16	***
## Countyleon	1.071e+02	1.295e+01	8.272	< 2e-16	***
## Countylewis	8.717e+01	1.314e+01	6.636	3.26e-11	***
## Countylexington	1.045e+02	1.291e+01	8.095	5.87e-16	***
## Countylinn	9.793e+01	1.298e+01	7.545	4.61e-14	***

## Countylitchfield	1.048e+02	1.339e+01	7.825	5.17e-15	***
## Countylorain	8.642e+01	1.296e+01	6.670	2.59e-11	***
## Countylosangeles	-3.354e+01	1.026e+01	-3.267	0.001086	**
## Countylowndes	1.031e+02	1.300e+01	7.927	2.28e-15	***
## Countylubbock	1.352e+02	1.882e+01	7.186	6.76e-13	***
## Countylucas	9.822e+01	1.288e+01	7.623	2.52e-14	***
## Countymacon	1.037e+02	1.316e+01	7.876	3.45e-15	***
## Countymadera	1.322e+02	1.298e+01	10.181	< 2e-16	***
## Countymadison	1.076e+02	1.294e+01	8.309	< 2e-16	***
## Countymahoning	1.044e+02	1.291e+01	8.089	6.14e-16	***
## Countymaricopa	-4.223e+01	2.011e+01	-2.100	0.035700	*
## Countymarin	1.049e+02	1.379e+01	7.608	2.84e-14	***
## Countymarion	9.908e+01	1.269e+01	7.809	5.86e-15	***
## Countymartin	1.035e+02	1.361e+01	7.599	3.04e-14	***
## Countymatanuskasusitna	1.231e+02	1.307e+01	9.420	< 2e-16	***
## Countymaui	9.342e+01	1.300e+01	7.188	6.69e-13	***
## Countymccracken	1.080e+02	1.325e+01	8.157	3.52e-16	***
## Countymchenry	1.050e+02	1.299e+01	8.084	6.41e-16	***
## Countymclean	1.100e+02	1.311e+01	8.393	< 2e-16	***
## Countymclennan	1.024e+02	1.316e+01	7.777	7.55e-15	***
## Countymcminn	1.017e+02	1.385e+01	7.346	2.08e-13	***
## Countymcered	1.260e+02	1.288e+01	9.778	< 2e-16	***
## Countymercer	1.191e+02	1.307e+01	9.118	< 2e-16	***
## Countymesa	1.210e+02	1.306e+01	9.262	< 2e-16	***
## Countymiamidade	6.131e+01	1.236e+01	4.961	7.04e-07	***
## Countymilwaukee	9.400e+01	1.276e+01	7.365	1.80e-13	***
## Countymobile	1.031e+02	1.325e+01	7.784	7.15e-15	***
## Countymohave	8.931e+01	1.313e+01	6.804	1.03e-11	***
## Countymonongalia	8.919e+01	1.321e+01	6.750	1.49e-11	***
## Countymonroe	1.016e+02	1.297e+01	7.830	4.97e-15	***
## Countymonterey	1.261e+02	1.303e+01	9.680	< 2e-16	***
## Countymontgomery	9.872e+01	1.280e+01	7.711	1.27e-14	***
## Countymorgan	1.568e+08	2.623e+08	0.598	0.549974	
## Countymultnomah	1.259e+06	2.105e+06	0.598	0.549931	
## Countymurray	8.517e+01	1.326e+01	6.421	1.36e-10	***
## Countymuscantine	1.076e+02	1.309e+01	8.218	< 2e-16	***
## Countymuscogee	1.065e+02	1.297e+01	8.208	2.30e-16	***
## Countynapa	1.139e+02	1.323e+01	8.609	< 2e-16	***
## Countynassau	1.118e+02	1.326e+01	8.427	< 2e-16	***
## Countynatrona	1.204e+02	1.496e+01	8.052	8.33e-16	***
## Countyneosho	1.112e+02	1.373e+01	8.098	5.69e-16	***
## Countynorthampton	1.146e+02	1.321e+01	8.676	< 2e-16	***
## Countynueces	1.052e+02	1.304e+01	8.069	7.24e-16	***
## Countyoklahoma	1.052e+02	1.275e+01	8.253	< 2e-16	***
## Countyorange	9.697e+01	1.294e+01	7.492	6.89e-14	***
## Countyorleans	1.044e+02	1.285e+01	8.120	4.75e-16	***
## Countyyouachita	1.126e+02	1.311e+01	8.586	< 2e-16	***
## Countyoutagamie	9.813e+01	1.310e+01	7.492	6.90e-14	***
## Countyoxford	1.089e+02	1.306e+01	8.344	< 2e-16	***
## Countyozaukee	9.845e+01	1.350e+01	7.290	3.14e-13	***
## Countypark	8.683e+01	1.321e+01	6.572	5.02e-11	***
## Countypenobscot	1.079e+02	1.298e+01	8.312	< 2e-16	***
## Countypeoria	1.081e+02	1.307e+01	8.269	< 2e-16	***
## Countyphiladelphia	9.407e+01	1.218e+01	7.723	1.15e-14	***

## Countypierce	1.097e+02	1.266e+01	8.663 < 2e-16 ***
## Countypima	1.048e+02	1.303e+01	8.042 9.00e-16 ***
## Countypinal	1.279e+02	1.294e+01	9.879 < 2e-16 ***
## Countypinellas	9.540e+01	1.272e+01	7.501 6.46e-14 ***
## Countypittsburg	1.131e+02	1.311e+01	8.627 < 2e-16 ***
## Countyplacer	1.214e+02	1.431e+01	8.488 < 2e-16 ***
## Countypolk	9.816e+01	1.286e+01	7.630 2.38e-14 ***
## Countyporter	9.611e+01	1.315e+01	7.310 2.71e-13 ***
## Countypottawattamie	9.483e+01	1.326e+01	7.153 8.62e-13 ***
## Countypotter	8.684e+01	1.310e+01	6.629 3.41e-11 ***
## Countyprovidence	1.066e+02	1.277e+01	8.349 < 2e-16 ***
## Countypueblo	8.356e+01	1.324e+01	6.310 2.82e-10 ***
## Countypulaski	1.113e+02	1.291e+01	8.620 < 2e-16 ***
## Countyrandolph	1.036e+02	1.343e+01	7.716 1.22e-14 ***
## Countyrapides	9.981e+01	1.319e+01	7.567 3.88e-14 ***
## Countyrichland	1.176e+02	1.301e+01	9.039 < 2e-16 ***
## Countyrichmond	1.128e+02	1.479e+01	7.624 2.50e-14 ***
## Countyriverside	1.182e+02	1.302e+01	9.076 < 2e-16 ***
## Countyroane	9.951e+01	1.319e+01	7.542 4.71e-14 ***
## Countyroanoke	1.021e+02	1.310e+01	7.796 6.52e-15 ***
## Countyrockingham	1.070e+02	1.315e+01	8.134 4.25e-16 ***
## Countyrussell	1.199e+02	1.318e+01	9.102 < 2e-16 ***
## Countyrutland	1.092e+02	1.316e+01	8.296 < 2e-16 ***
## Countysacramento	1.049e+02	1.221e+01	8.589 < 2e-16 ***
## Countysangamon	1.099e+02	1.324e+01	8.298 < 2e-16 ***
## Countysarasota	1.067e+02	1.297e+01	8.225 < 2e-16 ***
## Countysauk	9.770e+01	1.309e+01	7.464 8.51e-14 ***
## Countyscott	1.242e+02	1.306e+01	9.508 < 2e-16 ***
## Countysedgewick	1.065e+02	1.298e+01	8.208 2.31e-16 ***
## Countyseminole	1.048e+02	1.335e+01	7.845 4.43e-15 ***
## Countysequoyah	1.094e+02	1.308e+01	8.364 < 2e-16 ***
## Countyshasta	1.116e+02	1.573e+01	7.095 1.31e-12 ***
## Countyshawnee	1.101e+02	1.334e+01	8.256 < 2e-16 ***
## Countyshelby	9.534e+01	1.264e+01	7.540 4.78e-14 ***
## Countysheridan	1.203e+02	1.340e+01	8.979 < 2e-16 ***
## Countyskagit	9.995e+01	1.314e+01	7.604 2.93e-14 ***
## Countysnohomish	8.839e+01	1.261e+01	7.009 2.43e-12 ***
## Countysolano	1.105e+02	1.288e+01	8.576 < 2e-16 ***
## Countysonoma	1.024e+02	1.301e+01	7.872 3.56e-15 ***
## Countyspartanburg	1.064e+02	1.287e+01	8.272 < 2e-16 ***
## Countyspokane	9.855e+01	1.276e+01	7.723 1.16e-14 ***
## Countystanislaus	1.276e+02	1.277e+01	9.995 < 2e-16 ***
## Countysullivan	1.061e+02	1.357e+01	7.819 5.45e-15 ***
## Countysumner	9.137e+01	1.483e+01	6.162 7.25e-10 ***
## Countysussex	1.106e+02	1.309e+01	8.448 < 2e-16 ***
## Countysutter	1.211e+02	1.305e+01	9.283 < 2e-16 ***
## Countysweetwater	1.284e+02	1.543e+01	8.322 < 2e-16 ***
## Countytalladega	1.069e+02	1.301e+01	8.213 < 2e-16 ***
## Countytarrant	8.506e+01	1.187e+01	7.168 7.73e-13 ***
## Countytehama	1.053e+02	1.321e+01	7.972 1.59e-15 ***
## Countyterrebonne	1.004e+02	1.320e+01	7.609 2.82e-14 ***
## Countytioga	1.168e+02	1.316e+01	8.876 < 2e-16 ***
## Countytippecanoe	9.854e+01	1.292e+01	7.628 2.42e-14 ***
## Countytooele	1.098e+02	1.302e+01	8.430 < 2e-16 ***

```

## Countytravis      -1.640e+02 9.667e+01 -1.696 0.089860 .
## Countytucker     1.045e+02 1.397e+01 7.480 7.58e-14 ***
## Countytulare     1.378e+02 1.277e+01 10.791 < 2e-16 ***
## Countytulsa      1.101e+02 1.286e+01 8.562 < 2e-16 ***
## Countytuscaloosa 1.048e+02 1.268e+01 8.260 < 2e-16 ***
## Countyuintah      1.275e+02 1.356e+01 9.398 < 2e-16 ***
## Countyumatilla    9.392e+01 1.312e+01 7.161 8.11e-13 ***
## Countyutah        -1.887e+02 3.796e+01 -4.970 6.72e-07 ***
## Countyvanderburgh 1.128e+02 1.299e+01 8.684 < 2e-16 ***
## Countyventura     1.110e+02 1.267e+01 8.764 < 2e-16 ***
## Countyvigo         1.110e+02 1.304e+01 8.518 < 2e-16 ***
## Countyvolusia     1.012e+02 1.285e+01 7.875 3.48e-15 ***
## Countywakulla      1.152e+02 1.307e+01 8.817 < 2e-16 ***
## Countywasco        9.891e+01 1.312e+01 7.539 4.80e-14 ***
## Countywashington   1.055e+02 1.299e+01 8.118 4.86e-16 ***
## Countywebb         1.099e+02 1.279e+01 8.591 < 2e-16 ***
## Countyweber        1.308e+02 1.298e+01 10.078 < 2e-16 ***
## Countyweld         1.166e+02 1.303e+01 8.951 < 2e-16 ***
## Countywestmoreland 1.129e+02 1.289e+01 8.758 < 2e-16 ***
## Countywhatcom      1.087e+03 1.547e+02 7.030 2.10e-12 ***
## Countywhitley      1.035e+02 1.305e+01 7.931 2.21e-15 ***
## Countywhitman      9.061e+01 1.302e+01 6.961 3.41e-12 ***
## Countywill         9.399e+01 1.291e+01 7.278 3.43e-13 ***
## Countywinnebago    1.061e+02 1.320e+01 8.038 9.37e-16 ***
## Countywood          8.848e+06 1.477e+07 0.599 0.549290
## Countywoodbury     9.652e+01 1.441e+01 6.698 2.14e-11 ***
## Countywyandotte   1.146e+02 1.296e+01 8.840 < 2e-16 ***
## Countyyyakima      1.079e+02 1.289e+01 8.374 < 2e-16 ***
## Countyyyavapai     8.563e+01 1.434e+01 5.973 2.34e-09 ***
## Countyyyolo         1.152e+02 1.309e+01 8.807 < 2e-16 ***
## Countyyyork         1.064e+02 1.307e+01 8.139 4.09e-16 ***
## Countyyyuma         1.230e+02 1.306e+01 9.421 < 2e-16 ***
## Nitrous.Oxide      5.520e+04 9.234e+04 0.598 0.549975
## NF3                5.520e+04 9.234e+04 0.598 0.549975
## Other.GHG          NA       NA       NA       NA
## Total.Emissions    -5.520e+04 9.234e+04 -0.598 0.549975
## HFC                5.520e+04 9.234e+04 0.598 0.549975
## Other.Fluorane     5.520e+04 9.234e+04 0.598 0.549975
## Biogenic.CO2       -4.132e-06 8.632e-07 -4.787 1.70e-06 ***
## Population         1.576e-05 1.062e-06 14.843 < 2e-16 ***
## CO2                5.520e+04 9.234e+04 0.598 0.549975
## PFC                5.520e+04 9.234e+04 0.598 0.549975
## HFE                5.520e+04 9.234e+04 0.598 0.549976
## Stationary.Combustion -1.581e-08 1.307e-07 -0.121 0.903759
## pp_consumed_MMBtu  7.476e-07 1.740e-07 4.297 1.74e-05 ***
## Temperature        -5.510e-02 7.483e-03 -7.363 1.82e-13 ***
## Methane            5.520e+04 9.234e+04 0.598 0.549975
## SF6                5.520e+04 9.234e+04 0.598 0.549975
## Short.Lived.Compounds 5.520e+04 9.234e+04 0.598 0.549977
## Income             -2.234e-06 3.146e-05 -0.071 0.943380
## pp_net_gen_MWh    -5.815e-06 1.654e-06 -3.516 0.000439 ***
## ---

## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##

```

```

## Residual standard error: 15.44 on 49966 degrees of freedom
## Multiple R-squared:  0.3855, Adjusted R-squared:  0.3813
## F-statistic: 93.27 on 336 and 49966 DF,  p-value: < 2.2e-16

```

Defining Parameter = PM.10

```

pm10.lmod <- lm(formula = AQI ~ Nitrous.Oxide + NF3 + Other.GHG + Total.Emissions + HFC + Other.Fluorane + Biogenic.CO2 + Population + CO2 + PFC + HFE + Stationary.Combustion + pp_consumed_MMBtu + Temperature + Methane + SF6 + Short.Lived.Compounds + Income + pp_net_gen_MWh, data = data_PM10)

## Call:
## lm(formula = AQI ~ Nitrous.Oxide + NF3 + Other.GHG + Total.Emissions +
##      HFC + Other.Fluorane + Biogenic.CO2 + Population + CO2 +
##      PFC + HFE + Stationary.Combustion + pp_consumed_MMBtu + Temperature +
##      Methane + SF6 + Short.Lived.Compounds + Income + pp_net_gen_MWh,
##      data = data_PM10)
## 
## Residuals:
##      Min    1Q   Median    3Q   Max
## -88.78 -14.74   -4.45   9.34 1205.79
## 
## Coefficients: (2 not defined because of singularities)
##              Estimate Std. Error t value Pr(>|t|)    
## (Intercept) 2.841e+01 2.224e+00 12.769 < 2e-16 ***
## Nitrous.Oxide 1.967e-04 9.356e-05 2.103 0.03554 *  
## NF3          -7.911e-04 2.006e-03 -0.394 0.69335    
## Other.GHG        NA         NA       NA      NA      
## Total.Emissions -1.943e-04 9.324e-05 -2.084 0.03725 *  
## HFC           1.860e-04 5.352e-04  0.347 0.72826    
## Other.Fluorane -1.277e-04 4.136e-04 -0.309 0.75751    
## Biogenic.CO2   -1.321e-05 1.331e-06 -9.921 < 2e-16 ***
## Population     1.282e-05 1.135e-06 11.292 < 2e-16 *** 
## CO2            1.927e-04 9.324e-05  2.066 0.03886 *  
## PFC            3.036e-04 2.967e-04  1.023 0.30624    
## HFE            3.718e-01 1.572e+00  0.236 0.81307    
## Stationary.Combustion 9.221e-07 3.868e-07  2.384 0.01717 *  
## pp_consumed_MMBtu 1.593e-06 7.637e-07  2.086 0.03701 *  
## Temperature    5.929e-01 3.926e-02 15.103 < 2e-16 *** 
## Methane         2.108e-04 9.297e-05  2.268 0.02339 *  
## SF6             NA         NA       NA      NA      
## Short.Lived.Compounds 1.256e+05 1.432e+05  0.877 0.38067  
## Income          -1.084e-04 4.001e-05 -2.709 0.00678 ** 
## pp_net_gen_MWh -1.401e-05 7.045e-06 -1.989 0.04677 *  
## ---            
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
## 
## Residual standard error: 29.63 on 5326 degrees of freedom
## Multiple R-squared:  0.1933, Adjusted R-squared:  0.1907
## F-statistic: 75.05 on 17 and 5326 DF,  p-value: < 2.2e-16
pm10_geo.lmod <- lm(formula = AQI ~ County + Nitrous.Oxide + NF3 + Other.GHG + Total.Emissions + HFC + Other.Fluorane + Biogenic.CO2 + Population + CO2 + PFC + HFE + Stationary.Combustion + pp_consumed_MMBtu + Temperature + Methane + SF6 + Short.Lived.Compounds + Income + pp_net_gen_MWh, data = data_PM10)

```

```
summary(pm10_geo.lmod)
```

```
##  
## Call:  
## lm(formula = AQI ~ County + Nitrous.Oxide + NF3 + Other.GHG +  
##      Total.Emissions + HFC + Other.Fluorane + Biogenic.CO2 + Population +  
##      CO2 + PFC + HFE + Stationary.Combustion + pp_consumed_MMBtu +  
##      Temperature + Methane + SF6 + Short.Lived.Compounds + Income +  
##      pp_net_gen_MWh, data = data_PM10)  
##  
## Residuals:  
##       Min     1Q   Median     3Q    Max  
## -52.35  -7.97   -2.44    5.03 1174.09  
##  
## Coefficients: (13 not defined because of singularities)  
##              Estimate Std. Error t value Pr(>|t|)  
## (Intercept) 3.017e+01 7.879e+00  3.829  0.00013 ***  
## Countyadams 1.521e+01 5.016e+01  0.303  0.76167  
## Countyalbany 1.064e+01 1.153e+01  0.923  0.35605  
## Countyanchorage 5.892e+00 1.254e+01  0.470  0.63843  
## Countyapache -1.646e+01 1.780e+02 -0.093  0.92630  
## Countyaroostook 2.701e+01 2.582e+01  1.046  0.29561  
## Countybannock -2.203e+00 9.200e+00 -0.239  0.81078  
## Countybenton -1.323e+01 6.125e+02 -0.022  0.98277  
## Countyblair   -2.158e+01 1.497e+01 -1.442  0.14946  
## Countybonner  -1.810e+01 8.809e+00 -2.054  0.04000 *  
## Countyboulder -1.276e+01 1.717e+01 -0.743  0.45765  
## Countycache   1.158e+01 1.629e+01  0.711  0.47713  
## Countycambria 1.521e+01 3.656e+01  0.416  0.67740  
## Countycampbell 2.371e+01 1.051e+02  0.225  0.82161  
## Countycanyon  -1.281e+01 1.129e+01 -1.135  0.25633  
## Countycarroll -1.701e+01 2.581e+01 -0.659  0.50990  
## Countycharleston -5.105e+00 3.465e+01 -0.147  0.88290  
## Countycochise  1.252e+01 1.496e+03  0.008  0.99333  
## Countycolusa  9.940e+00 2.598e+01  0.383  0.70198  
## Countyconverse 1.778e+01 7.057e+01  0.252  0.80114  
## Countycook    1.549e+01 2.831e+01  0.547  0.58429  
## Countycumberland 2.029e+01 2.936e+01  0.691  0.48959  
## Countycuster  -1.129e+01 1.379e+01 -0.819  0.41298  
## Countydallas  6.090e-01 5.921e+01  0.010  0.99179  
## Countydane    -1.237e+01 2.432e+01 -0.508  0.61117  
## Countydelaware -2.284e+01 1.150e+01 -1.986  0.04712 *  
## Countydenver  1.841e+01 1.505e+01  1.223  0.22131  
## Countydubois -2.188e+01 1.908e+01 -1.147  0.25151  
## Countyfairbanksnorthstar 8.438e+00 1.184e+01  0.713  0.47606  
## Countyford    -1.847e+01 2.498e+01 -0.739  0.45973  
## Countyfresno  2.089e+01 2.075e+01  1.007  0.31418  
## Countygalveston 2.941e+01 1.715e+02  0.172  0.86382  
## Countygeorgetown -1.301e+01 5.104e+01 -0.255  0.79877  
## Countygila    1.997e+01 9.867e+00  2.024  0.04303 *  
## Countygoshen  1.402e+01 8.628e+00  1.624  0.10435  
## Countygreenville 2.442e+01 2.600e+01  0.939  0.34766  
## Countygunnison -5.928e+00 9.531e+00 -0.622  0.53401  
## Countyharris  3.012e+01 7.283e+02  0.041  0.96702
```

## Countyhidalgo	-6.982e+00	6.459e+01	-0.108	0.91392
## Countyhonolulu	-7.693e+00	7.742e+01	-0.099	0.92085
## Countyhumboldt	1.704e+00	1.318e+01	0.129	0.89712
## Countyimperial	3.950e+01	1.503e+01	2.628	0.00861 **
## Countyjefferson	-8.013e+00	2.490e+02	-0.032	0.97433
## Countyjohnson	-7.014e+00	1.628e+01	-0.431	0.66655
## Countyjuneau	-2.119e+01	1.172e+01	-1.808	0.07066 .
## Countykennebec	1.262e+01	1.910e+01	0.660	0.50901
## Countykern	1.825e+01	2.352e+02	0.078	0.93817
## Countykings	2.575e+01	9.420e+00	2.733	0.00629 **
## Countyknox	-2.486e+01	1.503e+01	-1.655	0.09801 .
## Countylake	1.068e+01	5.308e+02	0.020	0.98395
## Countylane	8.400e+00	1.910e+01	0.440	0.66017
## Countylapaz	-1.610e+01	9.156e+00	-1.759	0.07867 .
## Countylarimer	2.010e+01	4.150e+01	0.484	0.62809
## Countylee	-1.868e+01	5.574e+01	-0.335	0.73751
## Countylehigh	-1.996e+01	1.385e+01	-1.441	0.14960
## Countylexington	-2.532e+01	1.546e+01	-1.637	0.10161
## Countylincoln	-1.535e+01	9.408e+01	-0.163	0.87040
## Countylinn	1.247e+01	5.010e+01	0.249	0.80341
## Countylorain	-2.919e+01	2.879e+01	-1.014	0.31053
## Countylosangeles	2.145e+01	3.679e+02	0.058	0.95351
## Countyluzerne	-1.302e+01	1.152e+01	-1.130	0.25845
## Countylycoming	-1.699e+01	1.046e+01	-1.623	0.10458
## Countymadera	1.807e+01	1.045e+01	1.729	0.08391 .
## Countymadison	3.611e+01	9.023e+01	0.400	0.68901
## Countymaricopa	2.071e+01	1.452e+02	0.143	0.88658
## Countymarion	2.082e+01	3.505e+01	0.594	0.55265
## Countymatanuskasusitna	2.097e+01	9.212e+00	2.277	0.02283 *
## Countymerced	1.115e+01	1.775e+01	0.628	0.52999
## Countymilwaukee	5.200e+00	1.460e+02	0.036	0.97160
## Countymohave	-1.919e+01	2.026e+01	-0.947	0.34367
## Countymonterey	6.662e+00	3.695e+01	0.180	0.85693
## Countymontgomery	-9.804e+00	2.588e+01	-0.379	0.70486
## Countymuscantine	-1.855e+01	3.545e+01	-0.523	0.60083
## Countymuskogee	-1.533e+01	9.491e+01	-0.162	0.87166
## Countynapa	-7.290e+00	2.581e+01	-0.282	0.77758
## Countynatrona	-1.930e+00	1.917e+01	-0.101	0.91981
## Countynavajo	-1.691e+01	4.368e+01	-0.387	0.69865
## Countyneosho	-3.745e+00	2.686e+01	-0.139	0.88914
## Countyoklahoma	1.312e+01	6.972e+01	0.188	0.85077
## Countyorange	2.493e+01	4.182e+01	0.596	0.55115
## Countypark	-1.922e+01	1.005e+01	-1.912	0.05590 .
## Countypima	1.558e+01	1.977e+01	0.788	0.43065
## Countypinal	4.457e+01	1.847e+01	2.414	0.01583 *
## Countyplatte	-1.342e+01	1.392e+02	-0.096	0.92323
## Countypolk	1.705e+00	2.000e+01	0.085	0.93210
## Countyporter	1.215e+01	2.051e+02	0.059	0.95275
## Countypottawattamie	-1.268e+01	9.704e+01	-0.131	0.89604
## Countypueblo	-1.356e+01	1.171e+02	-0.116	0.90786
## Countyputnam	-1.841e+01	9.212e+01	-0.200	0.84165
## Countyriverside	5.494e+01	1.702e+01	3.229	0.00125 **
## Countyroane	2.356e+01	7.128e+01	0.330	0.74106
## Countyroutt	-1.534e+01	3.286e+01	-0.467	0.64066

```

## Countysauk           -1.676e+01  1.459e+01  -1.149  0.25077
## Countyscott          2.053e+01  3.003e+01   0.684  0.49413
## Countysedgwick       1.309e+01  1.387e+01   0.944  0.34523
## Countyseminole        -2.295e+01  1.216e+01  -1.887  0.05925 .
## Countysequoyah        -1.984e+01  1.515e+01  -1.309  0.19057
## Countyshawnee          1.711e-01  1.520e+01   0.011  0.99102
## Countysheridan         -1.143e+01  9.027e+00  -1.267  0.20533
## Countysonoma           -2.451e+00  1.459e+01  -0.168  0.86658
## Countyspokane          -2.906e+00  1.656e+01  -0.175  0.86075
## Countystanislaus       3.046e+00  2.031e+01   0.150  0.88079
## Countystutsman         -2.180e+01  1.031e+01  -2.115  0.03450 *
## Countysweetwater        2.635e+01  1.883e+02   0.140  0.88870
## Countytehama            -1.491e+01  2.584e+01  -0.577  0.56378
## Countytravis             2.499e+01  1.288e+02   0.194  0.84624
## Countytulare             1.881e+01  1.332e+01   1.413  0.15780
## Countyuinta              -1.618e+01  1.259e+01  -1.286  0.19865
## Countyutah                1.716e+01  2.180e+02   0.079  0.93726
## Countyventura             2.564e+01  1.997e+01   1.284  0.19924
## Countywebb                 8.159e-01  2.607e+01   0.031  0.97504
## Countyweber               1.137e+01  1.650e+01   0.690  0.49049
## Countyweld                  8.850e+00  7.444e+01   0.119  0.90537
## Countywoodbury             -2.987e+00  2.368e+03  -0.001  0.99899
## Countywyandotte            1.419e+01  2.163e+01   0.656  0.51180
## Countyyyakima              -1.552e+01  1.460e+01  -1.063  0.28787
## Countyyolo                  1.729e+01  2.588e+01   0.668  0.50404
## Countyyuma                  2.300e+01  9.568e+00   2.404  0.01626 *
## Nitrous.Oxide              3.018e-13  4.327e-03   0.000  1.00000
## NF3                           NA      NA      NA      NA
## Other.GHG                     NA      NA      NA      NA
## Total.Emissions            -5.457e-17  4.583e-06   0.000  1.00000
## HFC                           NA      NA      NA      NA
## Other.Fluorane                NA      NA      NA      NA
## Biogenic.CO2                   NA      NA      NA      NA
## Population                      NA      NA      NA      NA
## CO2                            -1.516e-15  2.004e-05   0.000  1.00000
## PFC                           NA      NA      NA      NA
## HFE                           NA      NA      NA      NA
## Stationary.Combustion          NA      NA      NA      NA
## pp_consumed_MMBtu            -2.291e-06  1.031e-06  -2.222  0.02632 *
## Temperature                  3.281e-01  3.850e-02   8.522 < 2e-16 ***
## Methane                         NA      NA      NA      NA
## SF6                            NA      NA      NA      NA
## Short.Lived.Compounds          NA      NA      NA      NA
## Income                          NA      NA      NA      NA
## pp_net_gen_MWh                2.212e-05  9.468e-06   2.337  0.01949 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 24.59 on 5220 degrees of freedom
## Multiple R-squared:  0.4554, Adjusted R-squared:  0.4425
## F-statistic: 35.48 on 123 and 5220 DF,  p-value: < 2.2e-16

```

Defining Parameter = so2

Note - commented out temporarily for new data - since it fails “Error in lm.fit(x, y, offset = offset, singular.ok = singular.ok, ...) : 0 (non-NA) cases”

```
so2.lmod <- lm(formula = AQI ~ Nitrous.Oxide + NF3 + Other.GHG + Total.Emissions + HFC + Other.Fluorane  
summary(so2.lmod)  
  
##  
## Call:  
## lm(formula = AQI ~ Nitrous.Oxide + NF3 + Other.GHG + Total.Emissions +  
##     HFC + Other.Fluorane + Biogenic.CO2 + Population + CO2 +  
##     PFC + HFE + Stationary.Combustion + pp_consumed_MMBtu + Temperature +  
##     Methane + SF6 + Short.Lived.Compounds + Income + pp_net_gen_MWh,  
##     data = data_SO2)  
##  
## Residuals:  
##      Min       1Q     Median      3Q      Max  
## -118.052  -27.844   -5.648   17.033  258.157  
##  
## Coefficients: (4 not defined because of singularities)  
##                                     Estimate Std. Error t value Pr(>|t|)  
## (Intercept)           1.715e+02  6.282e+00 27.306 < 2e-16 ***  
## Nitrous.Oxide        1.695e-03  2.726e-04  6.218 5.56e-10 ***  
## NF3                  -6.210e-03  2.610e-03 -2.380  0.0174 *  
## Other.GHG            -1.613e+00  3.051e-01 -5.286 1.31e-07 ***  
## Total.Emissions      -1.740e-03  2.729e-04 -6.376 2.02e-10 ***  
## HFC                  1.731e-03  2.726e-04  6.348 2.43e-10 ***  
## Other.Fluorane       NA          NA          NA          NA  
## Biogenic.CO2         -1.658e-05 1.968e-06 -8.424 < 2e-16 ***  
## Population          1.538e-04  6.771e-06 22.706 < 2e-16 ***  
## CO2                 1.737e-03  2.730e-04  6.364 2.19e-10 ***  
## PFC                 3.072e-03  3.082e-04  9.966 < 2e-16 ***  
## HFE                  NA          NA          NA          NA  
## Stationary.Combustion 3.279e-06  5.430e-07  6.039 1.69e-09 ***  
## pp_consumed_MMBtu    4.016e-06  8.303e-07  4.838 1.36e-06 ***  
## Temperature          1.232e+00  6.321e-02 19.494 < 2e-16 ***  
## Methane              1.748e-03  2.729e-04  6.404 1.69e-10 ***  
## SF6                  NA          NA          NA          NA  
## Short.Lived.Compounds NA          NA          NA          NA  
## Income                -3.789e-03 1.532e-04 -24.727 < 2e-16 ***  
## pp_net_gen_MWh       -5.410e-05 8.589e-06 -6.299 3.33e-10 ***  
## ---  
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1  
##  
## Residual standard error: 41.09 on 4012 degrees of freedom  
## Multiple R-squared:  0.3582, Adjusted R-squared:  0.3558  
## F-statistic: 149.3 on 15 and 4012 DF,  p-value: < 2.2e-16  
so2_geo.lmod <- lm(formula = AQI ~ County + Nitrous.Oxide + NF3 + Other.GHG + Total.Emissions + HFC + O  
summary(so2_geo.lmod)  
  
##
```

```

## Call:
## lm(formula = AQI ~ County + Nitrous.Oxide + NF3 + Other.GHG +
##     Total.Emissions + HFC + Other.Fluorane + Biogenic.CO2 + Population +
##     CO2 + PFC + HFE + Stationary.Combustion + pp_consumed_MMBtu +
##     Temperature + Methane + SF6 + Short.Lived.Compounds + Income +
##     PP_net_gen_MWh, data = data_S02)
##
## Residuals:
##      Min    1Q   Median    3Q   Max
## -114.622 -11.054 -2.216  3.789 185.672
##
## Coefficients: (10 not defined because of singularities)
##              Estimate Std. Error t value Pr(>|t|)    
## (Intercept) -2.513e+03 1.486e+03 -1.691 0.090966 .
## Countyallegheny -5.611e+03 3.452e+03 -1.626 0.104119
## Countyanderson 2.576e+03 1.577e+03 1.634 0.102336
## Countybannock 1.938e+03 1.098e+03 1.766 0.077452 .
## Countybeaver 4.205e+03 2.758e+03 1.525 0.127425
## Countybrunswick 6.177e+03 3.394e+03 1.820 0.068857 .
## Countybucks 6.144e+02 2.472e+02 2.485 0.012983 *
## Countycabell 1.985e+03 1.180e+03 1.683 0.092479 .
## Countycalcasieu 6.267e+02 2.928e+02 2.140 0.032422 *
## Countycambria 2.186e+03 1.285e+03 1.701 0.088979 .
## Countycarbon 2.031e+03 1.148e+03 1.769 0.077017 .
## Countycaribou 2.272e+03 1.321e+03 1.720 0.085592 .
## Countychatham 2.425e+04 1.189e+04 2.040 0.041435 *
## Countycitrus 3.828e+03 2.443e+03 1.567 0.117222
## Countyclinton 3.637e+03 2.071e+03 1.756 0.079135 .
## Countydane -4.089e+02 2.668e+02 -1.533 0.125464
## Countydaviess 2.265e+03 1.307e+03 1.733 0.083235 .
## Countydenver -9.750e+02 5.456e+02 -1.787 0.074008 .
## Countyduval -2.398e+03 1.424e+03 -1.683 0.092394 .
## Countyfairbanksnorthstar 2.060e+03 1.193e+03 1.727 0.084283 .
## Countyfloyd 1.609e+04 8.115e+03 1.983 0.047461 *
## Countyfranklin 5.225e+03 3.440e+03 1.519 0.128859
## Countyfulton -2.787e+03 1.606e+03 -1.736 0.082664 .
## Countygalveston -8.866e+02 7.303e+02 -1.214 0.224818
## Countygibson 3.710e+03 2.117e+03 1.753 0.079714 .
## Countygila 2.305e+03 1.305e+03 1.766 0.077503 .
## Countygreenup 2.177e+03 1.266e+03 1.720 0.085447 .
## Countygregg 1.704e+03 9.627e+02 1.770 0.076861 .
## Countyharrison 2.383e+03 1.400e+03 1.702 0.088781 .
## Countyhawaii 1.606e+03 8.739e+02 1.838 0.066133 .
## Countyhillsborough 1.839e+03 8.980e+02 2.048 0.040656 *
## Countyhoward 2.078e+03 1.196e+03 1.738 0.082359 .
## Countyhutchinson 1.134e+03 5.402e+02 2.099 0.035889 *
## Countyindiana 6.214e+03 4.083e+03 1.522 0.128173
## Countyjefferson -3.500e+02 5.079e+02 -0.689 0.490808
## Countykanawha -4.211e+02 6.471e+02 -0.651 0.515313
## Countykauai 2.061e+03 1.214e+03 1.698 0.089603 .
## Countykay 1.933e+03 1.077e+03 1.795 0.072675 .
## Countylake -9.463e+03 6.547e+03 -1.445 0.148462
## Countylapaz 2.199e+03 1.268e+03 1.734 0.082924 .
## Countylarame 8.978e+03 5.969e+03 1.504 0.132595

```

## Countylawrence	1.933e+03	1.141e+03	1.694	0.090371	.
## Countylexington	1.361e+03	8.658e+02	1.572	0.116127	
## Countylinn	2.102e+03	1.161e+03	1.810	0.070380	.
## Countylucas	-5.887e+02	4.077e+02	-1.444	0.148837	
## Countymacon	3.003e+03	1.773e+03	1.693	0.090478	.
## Countymadison	-2.037e+02	3.385e+02	-0.602	0.547365	
## Countymarion	1.416e+03	5.437e+02	2.604	0.009244	**
## Countymilam	4.185e+03	2.664e+03	1.571	0.116275	
## Countymobile	4.573e+03	2.170e+03	2.107	0.035140	*
## Countymonongalia	-1.854e+03	2.122e+03	-0.874	0.382343	
## Countymontgomery	8.295e+02	3.840e+02	2.160	0.030811	*
## Countymuscatine	2.433e+03	1.388e+03	1.753	0.079709	.
## Countymuskogee	3.369e+03	2.061e+03	1.635	0.102183	
## Countynassau	2.223e+04	1.119e+04	1.987	0.046963	*
## Countynorthampton	-1.625e+03	1.232e+03	-1.319	0.187246	
## Countyoneida	2.370e+03	1.399e+03	1.695	0.090213	.
## Countyorange	7.496e+03	3.538e+03	2.119	0.034166	*
## Countypeoria	1.221e+03	6.238e+02	1.958	0.050313	.
## Countypolk	-1.955e+03	2.016e+03	-0.970	0.332176	
## Countyposter	-1.485e+03	1.208e+03	-1.230	0.218755	
## Countypotter	2.369e+03	1.362e+03	1.739	0.082151	.
## Countyputnam	1.126e+04	5.956e+03	1.891	0.058692	.
## Countyrichmond	9.680e+04	6.385e+04	1.516	0.129542	
## Countyrobertson	5.443e+03	3.538e+03	1.538	0.124062	
## Countystutsman	2.568e+03	1.529e+03	1.680	0.093130	.
## Countysullivan	9.126e+03	4.484e+03	2.035	0.041907	*
## Countysweetwater	4.374e+03	2.757e+03	1.587	0.112687	
## Countytazewell	2.763e+03	1.669e+03	1.655	0.098019	.
## Countytitus	5.263e+03	3.411e+03	1.543	0.122930	
## Countyvigo	8.462e+02	3.398e+02	2.490	0.012809	*
## Countywarrick	3.371e+03	2.092e+03	1.611	0.107207	
## Countywashington	-3.678e+03	3.317e+03	-1.109	0.267682	
## Countywayne	2.099e+03	1.230e+03	1.706	0.088037	.
## Countywood	6.680e+02	2.506e+02	2.666	0.007712	**
## Countywoodbury	7.077e+04	4.887e+04	1.448	0.147671	
## Countyyork	1.485e+03	8.973e+02	1.655	0.098000	.
## Nitrous.Oxide	-1.277e-01	8.882e-02	-1.438	0.150562	
## NF3	NA	NA	NA	NA	
## Other.GHG	NA	NA	NA	NA	
## Total.Emissions	2.998e-03	2.366e-03	1.267	0.205169	
## HFC	-2.677e-03	2.039e-03	-1.312	0.189471	
## Other.Fluorane	NA	NA	NA	NA	
## Biogenic.CO2	-9.557e-03	4.648e-03	-2.056	0.039837	*
## Population	5.020e-03	2.865e-03	1.752	0.079774	.
## CO2	-2.615e-03	2.103e-03	-1.244	0.213711	
## PFC	NA	NA	NA	NA	
## HFE	NA	NA	NA	NA	
## Stationary.Combustion	NA	NA	NA	NA	
## pp_consumed_MMBtu	-3.127e-06	1.903e-06	-1.643	0.100504	
## Temperature	1.445e-01	4.079e-02	3.542	0.000402	***
## Methane	NA	NA	NA	NA	
## SF6	NA	NA	NA	NA	
## Short.Lived.Compounds	NA	NA	NA	NA	
## Income	NA	NA	NA	NA	

```

## pp_net_gen_MWh           3.851e-05  2.057e-05   1.872  0.061337 .
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 23.86 on 3942 degrees of freedom
## Multiple R-squared:  0.7873, Adjusted R-squared:  0.7827
## F-statistic: 171.7 on 85 and 3942 DF,  p-value: < 2.2e-16

```

Defining Parameter = no2

```

no2.lmod <- lm(formula = AQI ~ Nitrous.Oxide + NF3 + Other.GHG + Total.Emissions + HFC + Other.Fluorane

summary(no2.lmod)

##
## Call:
## lm(formula = AQI ~ Nitrous.Oxide + NF3 + Other.GHG + Total.Emissions +
##       HFC + Other.Fluorane + Biogenic.CO2 + Population + CO2 +
##       PFC + HFE + Stationary.Combustion + pp_consumed_MMBtu + Temperature +
##       Methane + SF6 + Short.Lived.Compounds + Income + pp_net_gen_MWh,
##       data = data_N02)
##
## Residuals:
##    Min      1Q  Median      3Q     Max
## -33.222  -8.660  -0.734   7.656  83.243
##
## Coefficients: (1 not defined because of singularities)
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept) 1.282e+01  1.219e+00 10.512 < 2e-16 ***
## Nitrous.Oxide 8.920e-05  4.646e-05  1.920 0.055006 .
## NF3        -1.848e-04  1.226e-04 -1.508 0.131714
## Other.GHG   -4.169e-01  1.500e-01 -2.779 0.005502 **
## Total.Emissions -1.008e-04  4.584e-05 -2.199 0.027998 *
## HFC         1.015e-04  4.594e-05  2.209 0.027261 *
## Other.Fluorane 7.721e-05  1.131e-04  0.683 0.494762
## Biogenic.CO2 -6.186e-06  1.634e-06 -3.785 0.000158 ***
## Population  3.903e-06  3.584e-07 10.892 < 2e-16 ***
## CO2         1.017e-04  4.581e-05  2.219 0.026567 *
## PFC          1.559e-04  4.793e-05  3.252 0.001164 **
## HFE         -2.074e-03  2.963e-03 -0.700 0.484047
## Stationary.Combustion -1.433e-06  2.412e-07 -5.938 3.33e-09 ***
## pp_consumed_MMBtu -3.862e-07  3.625e-07 -1.065 0.286894
## Temperature -8.525e-02  2.942e-02 -2.898 0.003791 **
## Methane     9.827e-05  4.578e-05  2.147 0.031921 *
## SF6          NA         NA         NA         NA
## Short.Lived.Compounds 4.523e+04  1.663e+04  2.720 0.006576 **
## Income      3.292e-04  2.299e-05 14.317 < 2e-16 ***
## pp_net_gen_MWh 4.790e-06  3.362e-06  1.424 0.154445
##
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 12.86 on 2243 degrees of freedom
## Multiple R-squared:  0.3197, Adjusted R-squared:  0.3143

```

```

## F-statistic: 58.57 on 18 and 2243 DF, p-value: < 2.2e-16
no2_geo.lmod <- lm(formula = AQI ~ County + Nitrous.Oxide + NF3 + Other.GHG + Total.Emissions + HFC + O

summary(no2_geo.lmod)

##
## Call:
## lm(formula = AQI ~ County + Nitrous.Oxide + NF3 + Other.GHG +
##     Total.Emissions + HFC + Other.Fluorane + Biogenic.CO2 + Population +
##     CO2 + PFC + HFE + Stationary.Combustion + pp_consumed_MMBtu +
##     Temperature + Methane + SF6 + Short.Lived.Compounds + Income +
##     pp_net_gen_MWh, data = data_NO2)
##
## Residuals:
##    Min      1Q  Median      3Q      Max 
## -33.174 -5.474 -0.641  4.361 64.430 
##
## Coefficients: (6 not defined because of singularities)
##              Estimate Std. Error t value Pr(>|t|)    
## (Intercept) -3.147e+02 7.537e+04 -0.004 0.99667  
## Countyadams  3.294e+02 7.496e+04  0.004 0.99649  
## Countyalameda 3.032e+02 7.402e+04  0.004 0.99673  
## Countyascension 2.934e+02 7.524e+04  0.004 0.99689  
## Countybaltimore 3.093e+02 7.463e+04  0.004 0.99669  
## Countybeaver   3.109e+02 7.531e+04  0.004 0.99671  
## Countybexar    2.550e+02 5.985e+04  0.004 0.99660  
## Countybradford 3.205e+02 7.557e+04  0.004 0.99662  
## Countybrazoria 3.005e+02 7.525e+04  0.004 0.99681  
## Countybroward   3.166e+02 7.488e+04  0.004 0.99663  
## Countycache    3.163e+02 7.525e+04  0.004 0.99665  
## Countycalcasieu 3.130e+02 7.524e+04  0.004 0.99668  
## Countycambria   3.103e+02 7.525e+04  0.004 0.99671  
## Countycanadian  3.052e+02 7.523e+04  0.004 0.99676  
## Countycarbon    3.048e+02 7.533e+04  0.004 0.99677  
## Countycentre    3.103e+02 7.521e+04  0.004 0.99671  
## Countycharleston 3.018e+02 7.926e+04  0.004 0.99696  
## Countychittenden 1.024e+03 2.458e+05  0.004 0.99668  
## Countycontracosta 2.915e+02 7.449e+04  0.004 0.99688  
## Countyconverse   3.295e+02 7.538e+04  0.004 0.99651  
## Countycook       3.131e+02 7.100e+04  0.004 0.99648  
## Countycumberland 3.128e+02 7.427e+04  0.004 0.99664  
## Countydallas     1.500e+03 3.482e+05  0.004 0.99656  
## Countydavidson   3.124e+02 7.474e+04  0.004 0.99667  
## Countydavis      3.195e+02 7.517e+04  0.004 0.99661  
## Countydekalb     3.253e+02 7.471e+04  0.004 0.99653  
## Countydelaware   3.075e+02 7.602e+04  0.004 0.99677  
## Countydenton     3.037e+02 7.479e+04  0.004 0.99676  
## Countydenver     3.219e+02 7.473e+04  0.004 0.99656  
## Countyduchesne   3.029e+02 7.533e+04  0.004 0.99679  
## Countyduval      3.199e+02 7.473e+04  0.004 0.99658  
## Countyellis       3.190e+02 7.546e+04  0.004 0.99663  
## Countyerie       3.171e+02 7.516e+04  0.004 0.99663  
## Countyessex      2.958e+02 7.651e+04  0.004 0.99692  
## Countyfairbanksnorthstar 3.079e+02 7.525e+04  0.004 0.99674

```

## Countyfairfax	2.912e+02	7.541e+04	0.004	0.99692
## Countyfayette	3.104e+02	7.507e+04	0.004	0.99670
## Countyfresno	3.381e+02	7.452e+04	0.005	0.99638
## Countyfulton	2.976e+02	7.445e+04	0.004	0.99681
## Countygalveston	3.115e+02	7.516e+04	0.004	0.99669
## Countygarrett	2.942e+02	7.532e+04	0.004	0.99688
## Countygrady	3.002e+02	7.530e+04	0.004	0.99682
## Countygreenville	3.142e+02	7.494e+04	0.004	0.99665
## Countygregg	2.911e+02	7.524e+04	0.004	0.99691
## Countyhampden	3.110e+02	7.507e+04	0.004	0.99670
## Countyharris	2.945e+02	7.187e+04	0.004	0.99673
## Countyhartford	3.032e+02	7.557e+04	0.004	0.99680
## Countyhenrico	3.025e+02	7.505e+04	0.004	0.99678
## Countyhonolulu	3.067e+02	7.548e+04	0.004	0.99676
## Countyhoward	2.985e+02	7.505e+04	0.004	0.99683
## Countyhumboldt	3.309e+02	7.522e+04	0.004	0.99649
## Countyhunt	3.000e+02	7.527e+04	0.004	0.99682
## Countyimperial	3.427e+02	7.520e+04	0.005	0.99636
## Countyjefferson	3.177e+02	7.501e+04	0.004	0.99662
## Countykauai	3.034e+02	7.528e+04	0.004	0.99679
## Countykaufman	3.170e+02	7.544e+04	0.004	0.99665
## Countykennebec	2.957e+02	7.524e+04	0.004	0.99686
## Countyking	2.989e+02	7.349e+04	0.004	0.99675
## Countylackawanna	3.171e+02	7.545e+04	0.004	0.99665
## Countylake	3.082e+02	7.511e+04	0.004	0.99673
## Countylapaz	2.966e+02	7.533e+04	0.004	0.99686
## Countylaramie	3.179e+02	7.526e+04	0.004	0.99663
## Countylosangeles	3.202e+02	6.921e+04	0.005	0.99631
## Countymaricopa	8.005e+02	1.829e+05	0.004	0.99651
## Countymarin	2.672e+02	7.506e+04	0.004	0.99716
## Countymarion	3.089e+02	7.535e+04	0.004	0.99673
## Countymccracken	2.947e+02	7.536e+04	0.004	0.99688
## Countymclennan	3.100e+02	7.518e+04	0.004	0.99671
## Countymiamidade	2.765e+02	7.425e+04	0.004	0.99703
## Countymilwaukee	3.126e+02	7.476e+04	0.004	0.99666
## Countymultnomah	2.562e+02	6.237e+04	0.004	0.99672
## Countynapa	2.960e+02	7.520e+04	0.004	0.99686
## Countynatrona	3.054e+02	7.525e+04	0.004	0.99676
## Countynorthhampton	3.055e+02	7.517e+04	0.004	0.99676
## Countyoklahoma	3.220e+02	7.472e+04	0.004	0.99656
## Countyorange	3.259e+02	7.445e+04	0.004	0.99651
## Countyorleans	3.195e+02	7.500e+04	0.004	0.99660
## Countyphiladelphia	3.232e+02	7.403e+04	0.004	0.99652
## Countypierce	3.098e+02	7.693e+04	0.004	0.99679
## Countypolk	3.034e+02	7.506e+04	0.004	0.99678
## Countyprovidence	3.232e+02	7.482e+04	0.004	0.99655
## Countypulaski	3.172e+02	7.505e+04	0.004	0.99663
## Countyrichland	3.214e+02	7.919e+04	0.004	0.99676
## Countyroanoke	3.041e+02	7.526e+04	0.004	0.99678
## Countyrockingham	3.117e+02	7.528e+04	0.004	0.99670
## Countyrutland	3.006e+02	7.528e+04	0.004	0.99681
## Countysacramento	3.172e+02	7.425e+04	0.004	0.99659
## Countyseswick	3.095e+02	7.491e+04	0.004	0.99670
## Countysequoyah	3.083e+02	7.532e+04	0.004	0.99673

```

## Countyshelby      3.089e+02  7.467e+04  0.004  0.99670
## Countyskagit     3.026e+02  7.592e+04  0.004  0.99682
## Countysolano      3.143e+02  7.499e+04  0.004  0.99666
## Countystanislaus 3.207e+02  7.523e+04  0.004  0.99660
## Countysullivan    2.982e+02  7.702e+04  0.004  0.99691
## Countytarrant     3.176e+02  7.363e+04  0.004  0.99656
## Countytioga       2.980e+02  7.531e+04  0.004  0.99684
## Countytravis      3.228e+03  7.542e+05  0.004  0.99659
## Countytulsa       3.172e+02  7.522e+04  0.004  0.99664
## Countyuintah      3.901e+02  7.535e+04  0.005  0.99587
## Countyutah        4.541e+02  9.814e+04  0.005  0.99631
## Countyvanderburgh 3.129e+02  7.522e+04  0.004  0.99668
## Countywashington   3.257e+02  7.521e+04  0.004  0.99654
## Countyweber        3.343e+02  7.514e+04  0.004  0.99645
## Countywhitley     2.977e+02  7.531e+04  0.004  0.99685
## Countywyandotte   3.238e+02  7.522e+04  0.004  0.99657
## Countyyolo         3.105e+02  7.515e+04  0.004  0.99670
## Countyyork         2.996e+02  7.673e+04  0.004  0.99688
## Nitrous.Oxide     1.584e-12  9.378e-05  0.000  1.00000
## NF3                -2.399e-02 5.635e+00 -0.004  0.99660
## Other.GHG          NA        NA        NA        NA
## Total.Emissions    -3.549e-13 9.562e-05  0.000  1.00000
## HFC                1.234e-06  5.140e-05  0.024  0.98084
## Other.Fluorane    1.554e-02  3.724e+00  0.004  0.99667
## Biogenic.CO2       -6.283e-11 4.454e-03  0.000  1.00000
## Population         1.514e-06  8.763e-04  0.002  0.99862
## CO2                4.914e-14  9.985e-05  0.000  1.00000
## PFC                NA        NA        NA        NA
## HFE                NA        NA        NA        NA
## Stationary.Combustion 1.974e-13 7.673e-06  0.000  1.00000
## pp_consumed_MMBtu  1.849e-06  8.259e-07  2.239  0.02525 *
## Temperature        -7.799e-02 2.647e-02 -2.946  0.00326 **
## Methane             NA        NA        NA        NA
## SF6                NA        NA        NA        NA
## Short.Lived.Compounds  NA        NA        NA        NA
## Income              6.652e-04  1.230e-03  0.541  0.58858
## pp_net_gen_MWh    -1.339e-05 6.477e-06 -2.067  0.03887 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 9.424 on 2142 degrees of freedom
## Multiple R-squared:  0.6512, Adjusted R-squared:  0.6318
## F-statistic: 33.61 on 119 and 2142 DF, p-value: < 2.2e-16

```

Defining Parameter = co

```

co.lmod <- lm(formula = AQI ~ Nitrous.Oxide + NF3 + Other.GHG + Total.Emissions +
summary(co.lmod)

##
## Call:
## lm(formula = AQI ~ Nitrous.Oxide + NF3 + Other.GHG + Total.Emissions +

```

```

##      HFC + Other.Fluorane + Biogenic.CO2 + Population + CO2 +
##      PFC + HFE + Stationary.Combustion + pp_consumed_MMBtu + Temperature +
##      Methane + SF6 + Short.Lived.Compounds + Income + pp_net_gen_MWh,
##      data = data_CO)
##
## Residuals:
##      Min      1Q Median      3Q      Max
## -3.2095 -0.6586  0.0000  0.4949  5.0341
##
## Coefficients: (10 not defined because of singularities)
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept) -4.474e+02  1.306e+02 -3.427  0.00170 **
## Nitrous.Oxide -6.439e-01  1.867e-01 -3.450  0.00160 **
## NF3             NA        NA     NA     NA
## Other.GHG       NA        NA     NA     NA
## Total.Emissions 1.107e-03  3.197e-04  3.463  0.00154 **
## HFC             NA        NA     NA     NA
## Other.Fluorane  NA        NA     NA     NA
## Biogenic.CO2    1.953e-02  5.660e-03  3.450  0.00159 **
## Population     -3.766e-05 2.244e-05 -1.678  0.10300
## CO2             1.854e-03  5.392e-04  3.439  0.00164 **
## PFC             NA        NA     NA     NA
## HFE             NA        NA     NA     NA
## Stationary.Combustion -3.800e-03  1.102e-03 -3.448  0.00160 **
## pp_consumed_MMBtu -1.497e-04  4.358e-05 -3.436  0.00166 **
## Temperature     7.142e-02  4.918e-02  1.452  0.15620
## Methane          NA        NA     NA     NA
## SF6              NA        NA     NA     NA
## Short.Lived.Compounds  NA        NA     NA     NA
## Income            5.360e-03  1.600e-03  3.350  0.00208 **
## pp_net_gen_MWh   NA        NA     NA     NA
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 1.875 on 32 degrees of freedom
## Multiple R-squared:  0.6977, Adjusted R-squared:  0.6127
## F-statistic: 8.207 on 9 and 32 DF,  p-value: 3.353e-06
co_geo.lmod <- lm(formula = AQI ~ County + Nitrous.Oxide + NF3 + Other.GHG + Total.Emissions + HFC + Oth

summary(co_geo.lmod)

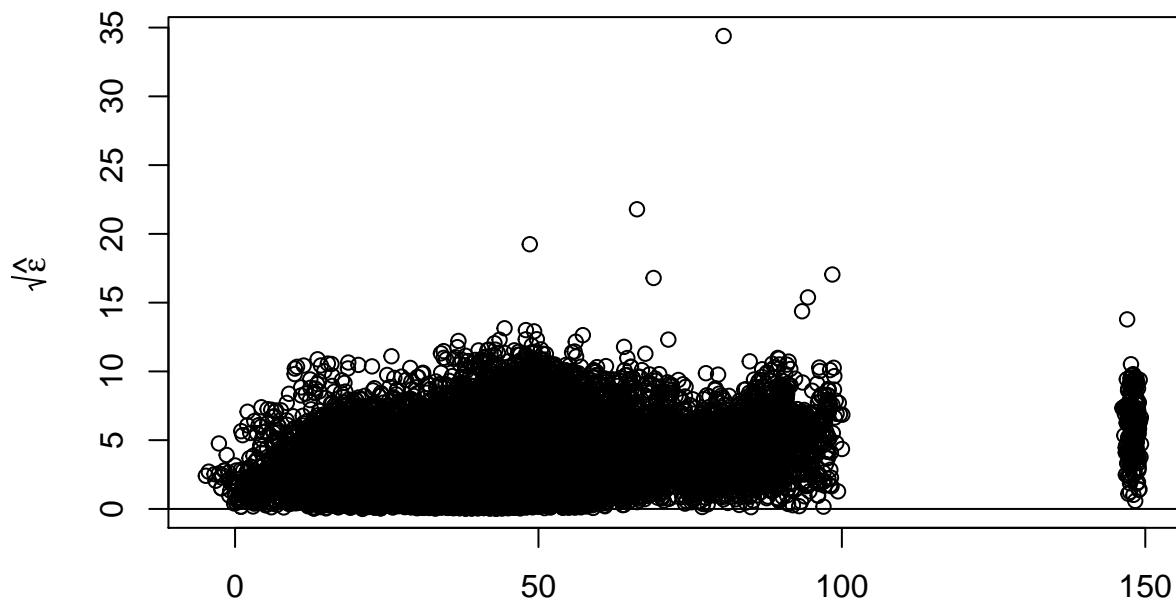
##
## Call:
## lm(formula = AQI ~ County + Nitrous.Oxide + NF3 + Other.GHG +
##     Total.Emissions + HFC + Other.Fluorane + Biogenic.CO2 + Population +
##     CO2 + PFC + HFE + Stationary.Combustion + pp_consumed_MMBtu +
##     Temperature + Methane + SF6 + Short.Lived.Compounds + Income +
##     pp_net_gen_MWh, data = data_CO)
##
## Residuals:
##      Min      1Q Median      3Q      Max
## -3.2095 -0.6586  0.0000  0.4949  5.0341
##
## Coefficients: (17 not defined because of singularities)

```

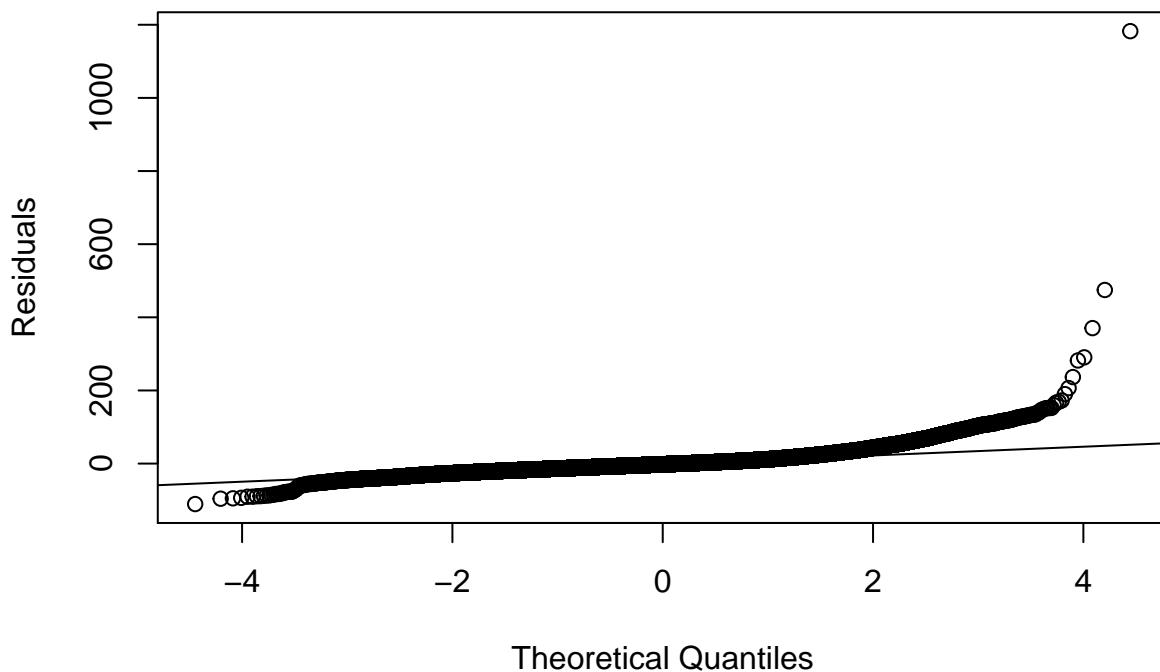
```

##                                     Estimate Std. Error t value Pr(>|t|)
## (Intercept)                   9.615e+02  2.767e+02   3.476  0.00149 **
## Countyhoward                -9.591e+02  2.767e+02  -3.466  0.00153 **
## Countykanawha               -9.341e+02  2.701e+02  -3.458  0.00156 **
## Countylake                    1.489e+02  4.637e+01   3.212  0.00300 **
## Countyspokane                -8.742e+02  2.553e+02  -3.424  0.00171 **
## Countysullivan               2.488e+02  7.254e+01   3.429  0.00169 **
## Countyvanderburgh            -9.577e+02  2.763e+02  -3.467  0.00152 **
## Countyywakulla              -4.091e+02  1.160e+02  -3.526  0.00130 **
## Nitrous.Oxide                  NA         NA       NA       NA
## NF3                           NA         NA       NA       NA
## Other.GHG                      NA         NA       NA       NA
## Total.Emissions                 NA         NA       NA       NA
## HFC                            NA         NA       NA       NA
## Other.Fluorane                 NA         NA       NA       NA
## Biogenic.CO2                   NA         NA       NA       NA
## Population                     NA         NA       NA       NA
## CO2                            NA         NA       NA       NA
## PFC                            NA         NA       NA       NA
## HFE                            NA         NA       NA       NA
## Stationary.Combustion          NA         NA       NA       NA
## pp_consumed_MMBtu           -1.497e-04  4.358e-05  -3.436  0.00166 **
## Temperature                   7.142e-02  4.918e-02   1.452  0.15620
## Methane                        NA         NA       NA       NA
## SF6                            NA         NA       NA       NA
## Short.Lived.Compounds          NA         NA       NA       NA
## Income                          NA         NA       NA       NA
## pp_net_gen_MWh                 NA         NA       NA       NA
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 1.875 on 32 degrees of freedom
## Multiple R-squared:  0.6977, Adjusted R-squared:  0.6127
## F-statistic: 8.207 on 9 and 32 DF,  p-value: 3.353e-06
#-----Constant Variance-----
#Plot residuals against fitted
plot(full.lmod$fitted.values, sqrt(abs(full.lmod$residuals)), xlab="Fitted", ylab=expression(sqrt(hat(e)))
abline(h=0)

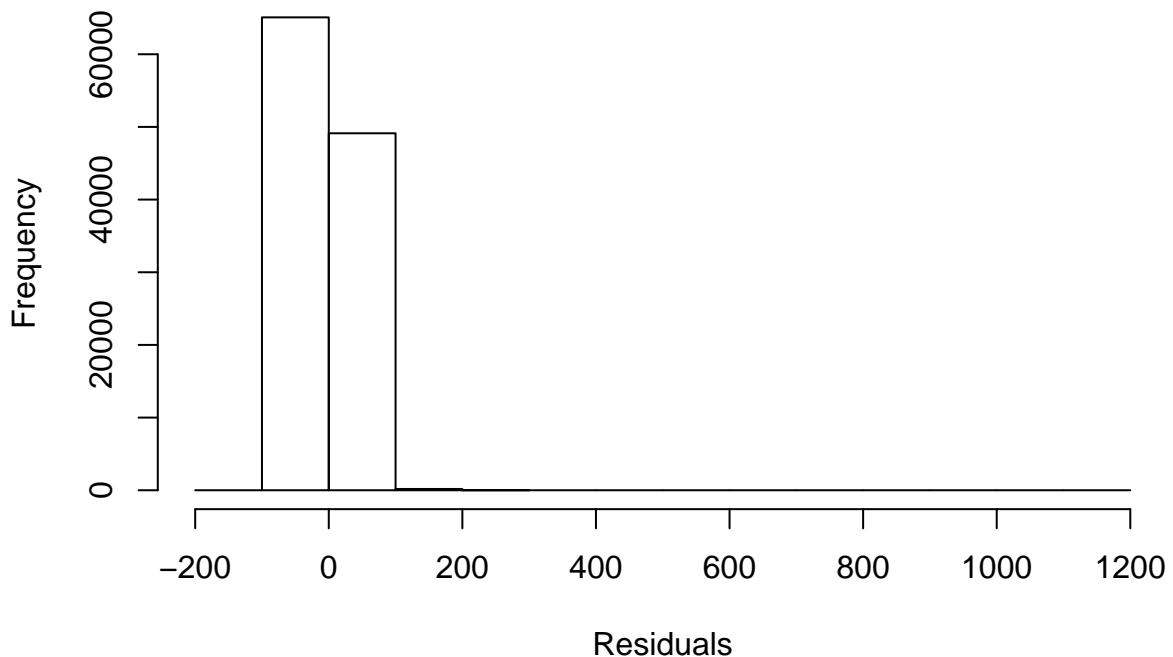
```



```
#-----Normality-----
#Checking normality with QQ-plot
qqnorm(full.lmod$residuals, ylab="Residuals", main="")
qqline(residuals(full.lmod))
```



```
#Checking normality with histogram of residuals
hist(residuals(full.lmod), xlab="Residuals", main="")
```



```
#Checking normality with Shapiro-Wilks test
shapiro.test(full.lmod$residuals[1:4999])
```

```
##
```

```
## Shapiro-Wilk normality test
```

```
##
```

```
## data: full.lmod$residuals[1:4999]
```

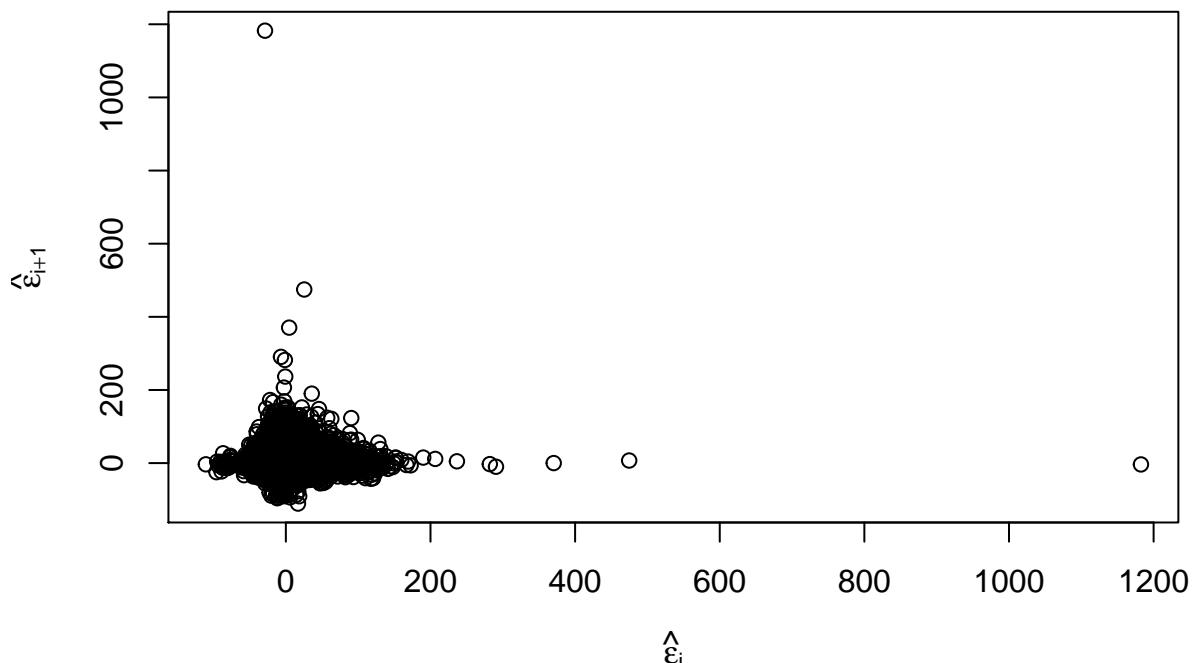
```
## W = 0.88824, p-value < 2.2e-16
```

```
#-----Timeseries Diagnostics-----
```

```
#Checking for serial correlation
```

```
n <- length(full.lmod$residuals)
```

```
plot(tail(full.lmod$residuals, n - 1) ~ head(full.lmod$residuals, n - 1), xlab=expression(hat(epsilon)) [
```

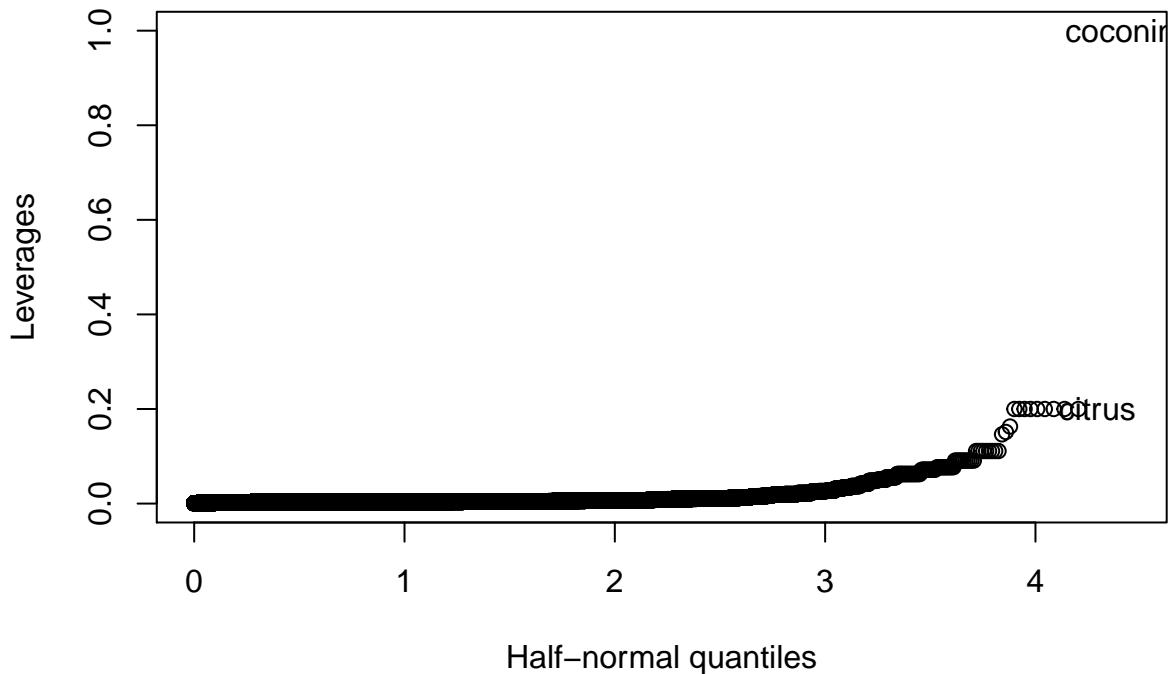


```

summary(lm(tail(full.lmod$residuals, n - 1) ~ head(full.lmod$residuals, n - 1)))

##
## Call:
## lm(formula = tail(full.lmod$residuals, n - 1) ~ head(full.lmod$residuals,
##                   n - 1))
##
## Residuals:
##      Min        1Q    Median        3Q       Max
## -110.58    -9.73    -2.01     6.40   1182.38
##
## Coefficients:
##                               Estimate Std. Error t value Pr(>|t|)
## (Intercept)                -0.000563   0.050822 -0.011   0.991
## head(full.lmod$residuals, n - 1) -0.003442   0.002957 -1.164   0.244
##
## Residual standard error: 17.19 on 114381 degrees of freedom
## Multiple R-squared:  1.185e-05, Adjusted R-squared:  3.108e-06
## F-statistic: 1.356 on 1 and 114381 DF, p-value: 0.2443
#-----Checking Leverage Points-----
hatv <- hatvalues(full.lmod)
halfnorm(hatv, labs=data$County, ylab="Leverages")

```



```
#-----Checking for Outliers-----
```

```
stud <- rstudent(full.lmod)
data[which.max(stud),]

##      AQI Biogenic.CO2      CO2 Category County County.Code Day
## 78523 31          0 2273820     Good bristol      5 27
## Defining.Parameter HFC HFE Income Methane Month NF3 Nitrous.Oxide
## 78523          Ozone 0 0 49019 28296.9    10 0 9882.276
## Other.Fluorane Other.GHG PFC Population Region SF6
## 78523          0 0 558312 1 0
## Short.Lived.Compounds           State State.Code Stationary.Combustion
## 78523          0 massachusetts 25 1416.069
## Temperature Total.Emissions Unnamed..0 Year pp_consumed_MMBtu
## 78523 5.152857 2311999 162267 2016 3105263
## pp_net_gen_MWh date
## 78523 301549.1 300
```

Errors appear to be approximately constant, by examination of the residuals vs. fitted. However, the histogram, QQ-plots, and Shapiro-Wilks indicate that the data is strongly non-normal. Data transformations are clearly required. Additionally, residuals display moderate serial correlation ($R^2 = 0.45$ for a serial regression). Generalized least squares can resolve this issue.

Furthermore, we find that Pinal County (Arizona) represents an extreme outlier on 7/29/2016 (from its large studentized error). Its removal, however, does not significantly affect the model, since the dataset is large.

```
#Generating correlation matrix
```

```
cor(data[,c("AQI", "HFC", "Other.GHG", "SF6", "Stationary.Combustion", "Biogenic.CO2", "HFE", "NF3", "P")])
```

```
##                  AQI          HFC      Other.GHG
## AQI 1.0000000000 0.0274317627 -0.0012940975
## HFC 0.027431763 1.0000000000 0.0008232892
## Other.GHG -0.001294097 0.0008232892 1.0000000000
## SF6 0.050682584 0.0098656984 -0.0077569924
## Stationary.Combustion 0.080887467 0.0052299485 0.0098153219
```

```

## Biogenic.CO2      -0.049562444 -0.0103973444 -0.0177476600
## HFE              -0.018768497  0.0509719507  0.0587111698
## NF3              0.029549743  0.0285543944 -0.0058424635
## PFC              -0.006122194  0.0220890559  0.2403322063
## Short.Lived.Compounds -0.011129040  0.0756128984  0.6473672708
## Temperature      0.189153174 -0.0140957155  0.0125484984
## pp_consumed_MMBtu 0.064987831  0.0554494370 -0.0003969303
## CO2              0.054339766  0.0912236128  0.0194285802
## Income            0.024279140  0.0063017320 -0.0409548892
## Nitrous.Oxide    -0.006184391  0.0006956590 -0.0044117651
## Population        0.213677011  0.0298347441 -0.0183826240
## Total.Emissions   0.057063489  0.1176411547  0.0218625222
## pp_net_gen_MWh   0.070745214  0.0664702294  0.0063015428
## Methane           0.058740819 -0.0075809343  0.0028250213
## Other.Fluorane   0.040958840  0.0228765892 -0.0022500009
## SF6 Stationary.Combustion Biogenic.CO2
## AQI               0.050682584  0.080887467 -0.049562444
## HFC               0.009865698  0.005229948 -0.010397344
## Other.GHG         -0.007756992  0.009815322 -0.017747660
## SF6               1.000000000 -0.012897976 -0.041558578
## Stationary.Combustion -0.012897976  1.000000000  0.027466733
## Biogenic.CO2      -0.041558578  0.027466733  1.000000000
## HFE               -0.002808708  -0.006646785 -0.016029356
## NF3               0.318801190  -0.021749366 -0.030664381
## PFC               0.222989361  0.002275598 -0.027112498
## Short.Lived.Compounds -0.012300871  0.040199199 -0.026848916
## Temperature       -0.018842677  0.030776585  0.046920719
## pp_consumed_MMBtu 0.033746768  0.316892339  0.119212225
## CO2               -0.001660156  0.789652133  0.006111616
## Income             0.027281684  0.044373262 -0.050949651
## Nitrous.Oxide     -0.008525871  0.029909279  0.185587877
## Population         0.132585515  0.365572614  0.067910273
## Total.Emissions   0.008008544  0.782288149  0.020543703
## pp_net_gen_MWh   0.036853331  0.253513658  0.075158265
## Methane            0.042889228  0.181752809  0.026959216
## Other.Fluorane   0.392111971 -0.030121276 -0.039461350
## HFE               -1.876850e-02  2.954974e-02 -0.006122194
## NF3               5.097195e-02  2.855439e-02  0.022089056
## Other.GHG         5.871117e-02 -5.842464e-03  0.240332206
## SF6               -2.808708e-03  3.188012e-01  0.222989361
## Stationary.Combustion -6.646785e-03 -2.174937e-02  0.002275598
## Biogenic.CO2      -1.602936e-02 -3.066438e-02 -0.027112498
## HFE               1.000000e+00  2.971686e-05  0.207984818
## NF3               2.971686e-05  1.000000e+00  0.561835182
## PFC               2.079848e-01  5.618352e-01  1.000000000
## Short.Lived.Compounds 5.528874e-01 -9.264637e-03  0.251064336
## Temperature       -7.679349e-03  3.918975e-02  0.013428214
## pp_consumed_MMBtu -2.253756e-02  4.479562e-02  0.018408088
## CO2               -2.073509e-02 -7.128473e-03  0.006877854
## Income             -2.851137e-02  7.600040e-02  0.026771617
## Nitrous.Oxide     -4.115670e-03 -1.779622e-03 -0.007625630
## Population         -1.760473e-02  1.681465e-01  0.121627937
## Total.Emissions   -1.601744e-02  1.051386e-02  0.027093652

```

```

## pp_net_gen_MWh      -2.126065e-02  5.346569e-02  0.026660761
## Methane             -7.982589e-03  8.459981e-02  0.077640504
## Other.Fluorane     1.910257e-03  8.628195e-01  0.526995030
## Short.Lived.Compounds Temperature pp_consumed_MMBtu
## AQI                  -0.011129040  0.189153174  0.0649878312
## HFC                   0.075612898  -0.014095716  0.0554494370
## Other.GHG            0.647367271  0.012548498  -0.0003969303
## SF6                  -0.012300871  -0.018842677  0.0337467680
## Stationary.Combustion 0.040199199  0.030776585  0.3168923393
## Biogenic.CO2          -0.026848916  0.046920719  0.1192122251
## HFE                   0.552887411  -0.007679349  -0.0225375611
## NF3                  -0.009264637  0.039189746  0.0447956212
## PFC                   0.251064336  0.013428214  0.0184080883
## Short.Lived.Compounds 1.000000000  -0.092679936  0.0025253241
## Temperature          -0.092679936  1.000000000  0.1295340398
## pp_consumed_MMBtu    0.002525324  0.129534040  1.000000000
## CO2                  0.016841263  0.080115352  0.5599177361
## Income                -0.057326462  -0.093108754  -0.0146867555
## Nitrous.Oxide         -0.006373178  0.039668878  0.0252767105
## Population            -0.031596532  0.103150671  0.3742028973
## Total.Emissions        0.021522635  0.086484944  0.5586015320
## pp_net_gen_MWh        0.005928788  0.136582569  0.9883437782
## Methane               -0.002952636  0.092233430  0.1535721597
## Other.Fluorane        -0.007543758  0.025934535  0.0595883336
## CO2                  Income Nitrous.Oxide Population
## AQI                  0.054339766  0.024279140  -0.006184391  0.213677011
## HFC                  0.091223613  0.006301732  0.000695659  0.029834744
## Other.GHG            0.019428580  -0.040954889  -0.004411765  -0.018382624
## SF6                  -0.001660156  0.027281684  -0.008525871  0.132585515
## Stationary.Combustion 0.789652133  0.044373262  0.029909279  0.365572614
## Biogenic.CO2          0.006111616  -0.050949651  0.185587877  0.067910273
## HFE                  -0.020735086  -0.028511367  -0.004115670  -0.017604726
## NF3                  -0.007128473  0.076000398  -0.001779622  0.168146500
## PFC                  0.006877854  0.026771617  -0.007625630  0.121627937
## Short.Lived.Compounds 0.016841263  -0.057326462  -0.006373178  -0.031596532
## Temperature          0.080115352  -0.093108754  0.039668878  0.103150671
## pp_consumed_MMBtu    0.559917736  -0.014686755  0.025276710  0.374202897
## CO2                  1.000000000  -0.014951232  0.054083278  0.380942863
## Income                -0.014951232  1.000000000  -0.035394386  0.238542933
## Nitrous.Oxide         0.054083278  -0.035394386  1.000000000  -0.002942146
## Population            0.380942863  0.238542933  -0.002942146  1.000000000
## Total.Emissions        0.994777116  -0.017943328  0.128588723  0.391643741
## pp_net_gen_MWh        0.514849051  -0.010872058  0.009749681  0.379628503
## Methane               0.234684159  -0.025489434  0.024039290  0.283620617
## Other.Fluorane        -0.005785139  0.059442757  -0.003046809  0.177873967
## Total.Emissions pp_net_gen_MWh Methane
## AQI                  0.057063489  0.070745214  0.058740819
## HFC                  0.117641155  0.066470229  -0.007580934
## Other.GHG            0.021862522  0.006301543  0.002825021
## SF6                  0.008008544  0.036853331  0.042889228
## Stationary.Combustion 0.782288149  0.253513658  0.181752809
## Biogenic.CO2          0.020543703  0.075158265  0.026959216
## HFE                  -0.016017442  -0.021260655  -0.007982589
## NF3                  0.010513863  0.053465691  0.084599811

```

```

## PFC                      0.027093652  0.026660761  0.077640504
## Short.Lived.Compounds   0.021522635  0.005928788 -0.002952636
## Temperature              0.086484944  0.136582569  0.092233430
## pp_consumed_MMBtu        0.558601532  0.988343778  0.153572160
## CO2                      0.994777116  0.514849051  0.234684159
## Income                   -0.017943328 -0.010872058 -0.025489434
## Nitrous.Oxide            0.128588723  0.009749681  0.024039290
## Population               0.391643741  0.379628503  0.283620617
## Total.Emissions           1.000000000  0.513955929  0.293410353
## pp_net_gen_MWh           0.513955929  1.000000000  0.152246892
## Methane                  0.293410353  0.152246892  1.000000000
## Other.Fluorane           0.010692280  0.072439055  0.075282304
##                               Other.Fluorane
## AQI                      0.040958840
## HFC                      0.022876589
## Other.GHG                 -0.002250001
## SF6                      0.392111971
## Stationary.Combustion    -0.030121276
## Biogenic.CO2              -0.039461350
## HFE                      0.001910257
## NF3                      0.862819519
## PFC                      0.526995030
## Short.Lived.Compounds   -0.007543758
## Temperature              0.025934535
## pp_consumed_MMBtu        0.059588334
## CO2                      -0.005785139
## Income                   0.059442757
## Nitrous.Oxide            -0.003046809
## Population               0.177873967
## Total.Emissions           0.010692280
## pp_net_gen_MWh           0.072439055
## Methane                  0.075282304
## Other.Fluorane           1.000000000
#Removing significantly collinear columns
data_nocol <- data[,-which(names(data) %in% c("pp_consumed_MMBtu","Total.Emissions"))]

#New fit
full.lmod.nocol <- lm(formula = AQI ~ Nitrous.Oxide + NF3 + Other.GHG + HFC + Other.Fluorane +
  Biogenic.CO2 + Population + CO2 + PFC + HFE + Stationary.Combustion + Temperature +
  Methane + SF6 + Short.Lived.Compounds + Income + pp_net_gen_MWh, data = data_nocol)

```

NOTE - gives an error with non-positive values for AQI. Fix it maybe!!

```

# #Making response AQI positive by adding a small constant (1) -- can change later
# data$AQI <- data$AQI + 1
#
# #Getting model Likelihoods on a range of parameters
# bx <- boxcox(full.lmod, plotit=T, lambda=seq(0.0, 0.5, by=0.001))
#
# #Getting best boxcox parameter -- lambda ~ 0.5
# lambda <- bx$x[which.max(bx$y)]
#
# #Transforming model accordingly
# full.lmod.T <- lm(formula = AQI ~ lambda ~ Nitrous.Oxide + NF3 + Other.GHG + Total.Emissions + HFC +

```

```
# + Temperature + Methane + SF6 + Short.Lived.Compounds + Income + pp_net_gen_MWh, data = data)
```

Although the likelihood is maximized by this value of lambda, we find that the R2 value is still small :(

```
full.glmmod <- gls(AQI ~ Nitrous.Oxide + NF3 + Other.GHG + Total.Emissions + HFC + Other.Fluorane +  
+ Biogenic.CO2 + Population + CO2 + PFC + HFE + Stationary.Combustion + pp_consumed_MMBtu + Temperature
```

THE END!!!