

ENGRD 302W Final Project

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Importing Libraries

```
## Loading libraries
library(ggplot2)
library(tidyverse)
```

```
## Warning: package 'tidyverse' was built under R version 4.3.3
```

```
## ─ Attaching core tidyverse packages ━━━━━━━━ tidyverse 2.0.0 ━━
## ✓ dplyr     1.1.3      ✓ readr     2.1.4
## ✓ forcats   1.0.0      ✓ stringr   1.5.0
## ✓ lubridate  1.9.2      ✓ tibble    3.2.1
## ✓ purrr    1.0.2      ✓ tidyverse  1.3.0
## ━━━━━━━━ Conflicts ━━━━━━━━ tidyverse_conflicts() ━━
## ✘ dplyr::filter() masks stats::filter()
## ✘ dplyr::lag()   masks stats::lag()
## i Use the conflicted package (<http://conflicted.r-lib.org/>) to force all conflicts to become errors
```

```
library(ggthemes)
```

```
## Warning: package 'ggthemes' was built under R version 4.3.3
```

```
library(dplyr)
library(maps)
```

```
## Warning: package 'maps' was built under R version 4.3.3
```

```
##
## Attaching package: 'maps'
##
## The following object is masked from 'package:purrr':
##
##     map
```

```
library(ggmap)
```

```
## Warning: package 'ggmap' was built under R version 4.3.3

## i Google's Terms of Service: <https://mapsplatform.google.com>
##   Stadia Maps' Terms of Service: <https://stadiamaps.com/terms-of-service/>
##   OpenStreetMap's Tile Usage Policy: <https://operations.osmfoundation.org/policies/tiles/>
## i Please cite ggmap if you use it! Use `citation("ggmap")` for details.
```

```
library(plotly)
```

```
## Warning: package 'plotly' was built under R version 4.3.3
```

```
##
## Attaching package: 'plotly'
##
## The following object is masked from 'package:ggmap':
##
##     wind
##
## The following object is masked from 'package:ggplot2':
##
##     last_plot
##
## The following object is masked from 'package:stats':
##
##     filter
##
## The following object is masked from 'package:graphics':
##
##     layout
```

```
library(stringr)
library(lubridate)
library(viridis)
```

```
## Warning: package 'viridis' was built under R version 4.3.3
```

```
## Loading required package: viridisLite
##
## Attaching package: 'viridis'
##
## The following object is masked from 'package:maps':
##
##     unemp
```

```
library(jpeg)
```

Separating Data

```
## Loading 2018 data
state_carbon_emission <- read.csv("C:/Users/13015/OneDrive - Emory University/Documents/Emory/Fall_23/ENGRD 302W/engrd302wfall2023/Data/state_carbon_emission.csv")
head(state_carbon_emission)
```

```
##      State X1970 X1971 X1972 X1973 X1974 X1975 X1976 X1977 X1978 X1979 X1980
## 1  Alabama 102.6  98.5 104.9 109.6 108.8 107.8 108.1 111.7 106.6 111.6 107.1
## 2   Alaska  11.3  12.6  13.4  12.5  12.8  14.5  16.0  18.0  19.5  17.5  17.4
## 3  Arizona  24.9  27.0  30.2  34.4  36.7  38.2  43.8  50.5  49.3  56.1  52.9
## 4 Arkansas  36.2  35.1  37.2  40.8  39.1  36.4  38.9  41.6  42.4  40.2  37.5
## 5 California 294.4 305.8 312.7 329.3 304.5 311.5 326.9 354.5 345.2 362.1 344.4
## 6 Colorado   43.0  43.6  47.5  51.1  50.5  51.8  55.1  58.3  58.4  58.9  58.9
##   X1981 X1982 X1983 X1984 X1985 X1986 X1987 X1988 X1989 X1990 X1991 X1992 X1993
## 1 103.8  90.9  89.9  95.3 101.6 101.7 103.7 104.9 109.9 109.6 113.9 120.7 125.2
## 2  17.0  23.9  25.9  28.6  29.0  31.4  29.7  30.2  33.3  33.9  34.5  35.8  35.7
## 3  59.9  58.5  54.2  58.5  61.1  56.3  56.4  59.6  65.5  63.1  63.9  66.7  69.0
## 4  42.9  42.7  47.1  45.0  49.1  50.0  47.1  51.0  51.3  50.8  49.7  51.3  50.4
## 5 334.2 298.8 293.5 315.5 320.6 306.7 335.8 344.6 359.4 360.2 348.5 352.3 341.9
## 6  57.8  59.0  57.2  60.9  61.5  60.7  61.4  63.8  65.0  66.5  67.7  68.7  72.4
##   X1994 X1995 X1996 X1997 X1998 X1999 X2000 X2001 X2002 X2003 X2004 X2005
## 1 123.2 131.0 137.2 134.1 133.5 135.84 142.3 133.32 138.3 139.8 142.0 143.5
## 2  35.5  40.0  41.1  41.2  42.2  42.86  43.6  42.55  42.7  42.9  46.2  47.5
## 3  71.8  66.7  68.6  71.7  76.7  80.62  86.6  88.86  88.3  90.5  97.3  97.3
## 4  54.3  57.7  60.2  59.2  60.5  62.72  63.3  62.50  61.2  62.2  62.5  60.2
## 5 359.3 348.8 349.8 352.7 362.7 366.10 382.3 385.56 384.4 374.6 392.7 389.6
## 6  73.0  73.1  76.0  76.2  78.4  80.46  85.5  93.30  91.6  91.0  93.5  95.8
##   X2006 X2007 X2008 X2009 X2010 X2011 X2012 X2013 X2014 X2015 X2016 X2017 X2018
## 1 145.8 147.3 139.4 119.8 132.5 129.5 122.6 120.5 122.6 119.2 114.0 108.6 112.4
## 2  45.4  43.7  39.1  37.3  37.1  37.1  36.2  34.0  33.9  35.0  33.4  33.7  34.5
## 3 100.5 102.4 102.6  93.9  99.5  97.7  95.5  99.3  97.3  95.0  90.9  90.5  94.1
## 4  62.1  63.4  64.2  61.5  66.1  67.5  66.3  68.5  68.9  59.1  62.1  64.2  70.8
## 5 397.8 402.6 384.0 370.4 356.6 342.7 348.8 349.7 345.4 351.4 353.4 356.5 358.6
## 6  96.6  99.3  97.4  93.3  95.9  92.5  91.2  92.1  92.8  91.3  88.4  88.8  90.1
##   X2019 X2020 X2021 Percent Absolute Percent.1 Absolute.1
## 1 106.3  98.4 108.4    5.6%     5.7    10.1%    10.0
## 2  34.3  36.0  38.9   242.5%    27.5    8.0%     2.9
## 3  92.6  80.2  83.0   233.3%    58.1    3.6%     2.9
## 4  65.1  54.7  62.0   71.4%    25.8   13.3%     7.3
## 5 358.3 303.8 324.0   10.1%    29.7    6.7%    20.2
## 6  91.7  79.9  85.4   98.5%    42.4    6.8%     5.5
```

```
state_df <- map_data("state")

## subsetting data
state_population_2018 <- read.csv("C:/Users/13015/OneDrive - Emory University/Documents/Emory/Fall_23/ENGRD 302W/engrd302wfall2023/Data/2018_state_population.csv")

state_asthma_2018 <- read.csv("C:/Users/13015/OneDrive - Emory University/Documents/Emory/Fall_23/ENGRD 302W/engrd302wfall2023/Data/2018_asthma_state_data.csv")

state_tax_2018 <- read.csv("C:/Users/13015/OneDrive - Emory University/Documents/Emory/Fall_23/ENGRD 302W/engrd302wfall2023/Data/2018_state_emission_tax_data.csv")
```

Data Cleaning

```
## standardizing variables
emission_df <- state_carbon_emission %>%
  rename(
    "1970" = "X1970",
    "1971" = "X1971",
    "1972" = "X1972",
    "1973" = "X1973",
    "1974" = "X1974",
    "1975" = "X1975",
    "1976" = "X1976",
    "1977" = "X1977",
    "1978" = "X1978",
    "1979" = "X1979",
    "1980" = "X1980",
    "1981" = "X1981",
    "1982" = "X1982",
    "1983" = "X1983",
    "1984" = "X1984",
    "1985" = "X1985",
    "1986" = "X1986",
    "1987" = "X1987",
    "1988" = "X1988",
    "1989" = "X1989",
    "1990" = "X1990",
    "1991" = "X1991",
    "1992" = "X1992",
    "1993" = "X1993",
    "1994" = "X1994",
    "1995" = "X1995",
    "1996" = "X1996",
    "1997" = "X1997",
    "1998" = "X1998",
    "1999" = "X1999",
    "2000" = "X2000",
    "2001" = "X2001",
    "2002" = "X2002",
    "2003" = "X2003",
    "2004" = "X2004",
    "2005" = "X2005",
    "2006" = "X2006",
    "2007" = "X2007",
    "2008" = "X2008",
    "2009" = "X2009",
    "2010" = "X2010",
    "2011" = "X2011",
    "2012" = "X2012",
    "2013" = "X2013",
    "2014" = "X2014",
    "2015" = "X2015",
    "2016" = "X2016",
    "2017" = "X2017",
    "2018" = "X2018",
```

```

"2019" = "X2019",
"2020" = "X2020",
"2021" = "X2021",
"state" = "State"
) %>%
mutate(state = tolower(state)) %>%
select(-Percent, -Absolute, -Percent.1, -Absolute.1) %>%
filter(state != "total of states") %>%
na.omit()

## cleaning format
emission_df[, c("1970", "1971", "1972", "1973", "1974", "1975", "1976", "1977", "1978", "1979",
"1980", "1981", "1982", "1983", "1984", "1985", "1986", "1987", "1988", "1989", "1990", "1991",
"1992", "1993", "1994", "1995", "1996", "1997", "1998", "1999", "2000", "2001", "2002", "2003",
"2004", "2005", "2006", "2007", "2008", "2009", "2010", "2011", "2012", "2013", "2014", "2015",
"2016", "2017", "2018", "2019", "2020", "2021")]
) <- lapply(emission_df[, c("1970", "1971", "1972", "1973", "1974", "1975", "1976", "1977", "1978",
"1979", "1980", "1981", "1982", "1983", "1984", "1985", "1986", "1987", "1988", "1989",
"1990", "1991", "1992", "1993", "1994", "1995", "1996", "1997", "1998", "1999", "2000", "2001",
"2002", "2003", "2004", "2005", "2006", "2007", "2008", "2009", "2010", "2011", "2012", "2013",
"2014", "2015", "2016", "2017", "2018", "2019", "2020", "2021"]
)], as.numeric) %>%
na.omit()

state_emission_df <- emission_df %>%
pivot_longer(cols = c(`1970`, `1971`, `1972`, `1973`, `1974`, `1975`, `1976`, `1977`, `1978`,
`1979`, `1980`, `1981`, `1982`, `1983`, `1984`, `1985`, `1986`, `1987`, `1988`, `1989`, `1990`,
`1991`, `1992`, `1993`, `1994`, `1995`, `1996`, `1997`, `1998`, `1999`, `2000`, `2001`, `2002`,
`2003`, `2004`, `2005`, `2006`, `2007`, `2008`, `2009`, `2010`, `2011`, `2012`, `2013`, `2014`,
`2015`, `2016`, `2017`, `2018`, `2019`, `2020`, `2021`),
),
names_to = "year",
values_to = "carbon_emission")

head(state_emission_df)

```

```

## # A tibble: 6 × 3
##   state   year carbon_emission
##   <chr>  <chr>        <dbl>
## 1 alabama 1970      103.
## 2 alabama 1971      98.5
## 3 alabama 1972      105.
## 4 alabama 1973      110.
## 5 alabama 1974      109.
## 6 alabama 1975      108.

```

Filtering 2019-2019 Carbon Emissions

```
state_carbon_emission_df <- state_emission_df %>%
  filter(year == c("2018", "2019")) %>%
  pivot_wider(names_from = year, values_from = carbon_emission) %>%
  rename(avg_2018_emission = "2018") %>%
  rename(avg_2019_emission = "2019") %>%
  mutate(pct_change = (c(avg_2019_emission)-c(avg_2018_emission))/c(avg_2018_emission))

head(state_carbon_emission_df)
```

```
## # A tibble: 6 × 4
##   state      avg_2018_emission avg_2019_emission pct_change
##   <chr>          <dbl>            <dbl>        <dbl>
## 1 alabama       112.             106.     -0.0543
## 2 alaska         34.5             34.3     -0.00580
## 3 arizona        94.1             92.6     -0.0159
## 4 arkansas       70.8             65.1     -0.0805
## 5 california    359.             358.    -0.000837
## 6 colorado       90.1             91.7      0.0178
```

More Cleaning

```

## removing subregion column
state_map_data <- state_df %>%
  select(-subregion)

## selecting for available data
state_population_2018 <- state_population_2018 %>%
  mutate(state = tolower(state)) %>%
  rename (total_population = estimated_population) %>%
  arrange(state) %>%
  filter(!(state %in% c("hawaii", "puerto rico")))

## 2018 emission tax data
state_tax_2018 <- state_tax_2018 %>%
  mutate(state = tolower(state)) %>%
  rename(emission_tax = gas_tax) %>%
  arrange(state) %>%
  filter(!(state %in% c("hawaii")))

## United States Asthma DF
state_asthma_2018 <- state_asthma_2018 %>%
  mutate(State.or.Territory = tolower(State.or.Territory)) %>%
  rename("state" = "State.or.Territory") %>%
  mutate(asthma_population = gsub(", ", "", Number.with.Current.Asthma)) %>%
  select(-Number.with.Current.Asthma) %>%
  arrange(state) %>%
  filter(!(state %in% c("hawaii", "guam", "puerto rico")))

state_asthma_2018$asthma_population <- as.numeric(state_asthma_2018$asthma_population)

head(state_asthma_2018)

```

```

##           state asthma_population
## 1      alabama          394634
## 2       alaska          50685
## 3     arizona          545104
## 4    arkansas          225853
## 5  california          2607598
## 6   colorado          399357

```

Joining Data Frames

```

## joining emission data w/ 2018 population data
state_final_df_2018 <- left_join(state_carbon_emission_df, state_population_2018, by = c("state" = "state")) %>%
  mutate(std_2018_emission = c(avg_2018_emission)/c(total_population))

## joining w/ 2018 asthma df
state_final_df_2018 <- left_join(state_final_df_2018, state_asthma_2018, by = c("state" = "state"))

## joining w/ geographical df
state_final_df_2018 <- left_join(state_final_df_2018, state_map_data, by = c("state" = "region"))

state_final_df_2018 <- state_final_df_2018 %>%
  mutate(pct_asthma_population = c(asthma_population)/c(total_population)) %>%
  select(state, avg_2018_emission, avg_2019_emission, pct_change, std_2018_emission, total_population, asthma_population, pct_asthma_population, long, lat, group, order)

head(state_final_df_2018)

```

```

## # A tibble: 6 × 12
##   state    avg_2018_emission avg_2019_emission pct_change std_2018_emission
##   <chr>        <dbl>            <dbl>      <dbl>          <dbl>
## 1 alabama     112.             106.     -0.0543       0.0000230
## 2 alabama     112.             106.     -0.0543       0.0000230
## 3 alabama     112.             106.     -0.0543       0.0000230
## 4 alabama     112.             106.     -0.0543       0.0000230
## 5 alabama     112.             106.     -0.0543       0.0000230
## 6 alabama     112.             106.     -0.0543       0.0000230
## # i 7 more variables: total_population <int>, asthma_population <dbl>,
## #   pct_asthma_population <dbl>, long <dbl>, lat <dbl>, group <dbl>,
## #   order <int>

```

```
summary(state_final_df_2018)
```

```

##      state      avg_2018_emission avg_2019_emission   pct_change
## Length:15539      Min.    : 2.9      Min.    : 2.8      Min.    :-0.080508
## Class :character 1st Qu.: 70.8      1st Qu.: 65.1      1st Qu.:-0.045049
## Mode  :character Median :110.1      Median :106.8      Median :-0.028481
##                  Mean    :161.4      Mean    :158.1      Mean    :-0.024201
##                  3rd Qu.:189.2      3rd Qu.:176.2      3rd Qu.:-0.002044
##                  Max.    :684.8      Max.    :683.4      Max.    : 0.069886
##
##      std_2018_emission total_population asthma_population pct_asthma_population
## Min.    :0.0000041      Min.    : 577737      Min.    : 38099      Min.    :0.05480
## 1st Qu.:0.0000114      1st Qu.: 4190713     1st Qu.: 316423     1st Qu.:0.06676
## Median :0.0000164      Median : 6770010     Median : 513084      Median :0.07280
## Mean    :0.0000188      Mean    : 9978405     Mean    : 690536      Mean    :0.07354
## 3rd Qu.:0.0000239      3rd Qu.:10519475    3rd Qu.: 872519     3rd Qu.:0.07906
## Max.    :0.0001104      Max.    :39557045     Max.    :2607598      Max.    :0.09872
## NA's    :1                  NA's    :1                  NA's    :1                  NA's    :1
##      long          lat       group       order
## Min.    :-124.68      Min.    :25.13      Min.    : 1.00      Min.    :    1
## 1st Qu.: -96.22      1st Qu.:33.91      1st Qu.:15.00      1st Qu.: 3899
## Median : -87.61      Median :38.18      Median :26.00      Median : 7794
## Mean    : -89.67      Mean    :38.18      Mean    :30.15      Mean    : 7798
## 3rd Qu.: -79.13      3rd Qu.:42.80      3rd Qu.:47.00      3rd Qu.:11699
## Max.    : -67.01      Max.    :49.38      Max.    :63.00      Max.    :15599
## NA's    :2                  NA's    :2                  NA's    :2                  NA's    :2

```

```

## joining 2018 emission tax df w/ geographical df
state_tax_map_data_2018 <- full_join(state_tax_2018, state_map_data, by = c("state" = "region"))

head(state_tax_map_data_2018)

```

```

##      state emission_tax      long       lat group order
## 1 alabama      18 -87.46201 30.38968     1    1
## 2 alabama      18 -87.48493 30.37249     1    2
## 3 alabama      18 -87.52503 30.37249     1    3
## 4 alabama      18 -87.53076 30.33239     1    4
## 5 alabama      18 -87.57087 30.32665     1    5
## 6 alabama      18 -87.58806 30.32665     1    6

```

```
summary(state_tax_map_data_2018)
```

```
##      state          emission_tax        long         lat
## Length:15540      Min.   : 8.95     Min.   :-124.68    Min.   :25.13
## Class :character  1st Qu.:20.12    1st Qu.:-96.22    1st Qu.:33.91
## Mode  :character  Median :26.30    Median :-87.61    Median :38.18
##                  Mean   :27.95    Mean   :-89.67    Mean   :38.18
##                  3rd Qu.:32.90    3rd Qu.:-79.13    3rd Qu.:42.80
##                  Max.   :57.60    Max.   :-67.01    Max.   :49.38
##                  NA's   :551     NA's   :3       NA's   :3
##      group          order
## Min.   : 1.00    Min.   : 1
## 1st Qu.:15.00   1st Qu.: 3899
## Median :26.00   Median : 7794
## Mean   :30.15   Mean   : 7798
## 3rd Qu.:47.00   3rd Qu.:11699
## Max.   :63.00   Max.   :15599
## NA's   :3       NA's   :3
```

```
## checking formatting
state_tax_map_data_2018 %>%
  filter(state == "missouri") %>%
  mutate(emission_tax = ifelse(is.na(emission_tax), as.numeric(17.300), emission_tax))
```

```

##      state emission_tax      long      lat group order
## 1 missouri        17.3 -95.75271 40.61125    27  7804
## 2 missouri        17.3 -95.37456 40.60552    27  7805
## 3 missouri        17.3 -95.20267 40.60552    27  7806
## 4 missouri        17.3 -94.91619 40.59979    27  7807
## 5 missouri        17.3 -94.63544 40.59406    27  7808
## 6 missouri        17.3 -94.48074 40.59406    27  7809
## 7 missouri        17.3 -94.24010 40.59406    27  7810
## 8 missouri        17.3 -94.01665 40.59979    27  7811
## 9 missouri        17.3 -93.77600 40.59979    27  7812
## 10 missouri       17.3 -93.56974 40.59979    27  7813
## 11 missouri       17.3 -93.37493 40.59979    27  7814
## 12 missouri       17.3 -93.09991 40.60552    27  7815
## 13 missouri       17.3 -92.68738 40.60552    27  7816
## 14 missouri       17.3 -92.63009 40.60552    27  7817
## 15 missouri       17.3 -92.34361 40.61125    27  7818
## 16 missouri       17.3 -92.17172 40.61698    27  7819
## 17 missouri       17.3 -91.93681 40.61698    27  7820
## 18 missouri       17.3 -91.70190 40.61698    27  7821
## 19 missouri       17.3 -91.66752 40.56541    27  7822
## 20 missouri       17.3 -91.61595 40.56541    27  7823
## 21 missouri       17.3 -91.58730 40.50812    27  7824
## 22 missouri       17.3 -91.52428 40.47374    27  7825
## 23 missouri       17.3 -91.48990 40.41644    27  7826
## 24 missouri       17.3 -91.41541 40.37634    27  7827
## 25 missouri       17.3 -91.43834 40.34769    27  7828
## 26 missouri       17.3 -91.46698 40.27893    27  7829
## 27 missouri       17.3 -91.48990 40.25029    27  7830
## 28 missouri       17.3 -91.49563 40.21018    27  7831
## 29 missouri       17.3 -91.50136 40.15861    27  7832
## 30 missouri       17.3 -91.48417 40.03829    27  7833
## 31 missouri       17.3 -91.46698 40.00964    27  7834
## 32 missouri       17.3 -91.42114 39.94089    27  7835
## 33 missouri       17.3 -91.44406 39.91797    27  7836
## 34 missouri       17.3 -91.45552 39.88359    27  7837
## 35 missouri       17.3 -91.44979 39.85494    27  7838
## 36 missouri       17.3 -91.38104 39.79765    27  7839
## 37 missouri       17.3 -91.36385 39.75754    27  7840
## 38 missouri       17.3 -91.35239 39.73462    27  7841
## 39 missouri       17.3 -91.33521 39.71170    27  7842
## 40 missouri       17.3 -91.28363 39.68306    27  7843
## 41 missouri       17.3 -91.18623 39.59711    27  7844
## 42 missouri       17.3 -91.16331 39.56846    27  7845
## 43 missouri       17.3 -91.10602 39.51117    27  7846
## 44 missouri       17.3 -91.06592 39.45387    27  7847
## 45 missouri       17.3 -91.03726 39.44241    27  7848
## 46 missouri       17.3 -90.97997 39.41377    27  7849
## 47 missouri       17.3 -90.93414 39.40231    27  7850
## 48 missouri       17.3 -90.89403 39.36793    27  7851
## 49 missouri       17.3 -90.81381 39.31063    27  7852
## 50 missouri       17.3 -90.76225 39.26480    27  7853
## 51 missouri       17.3 -90.74506 39.23615    27  7854

```

## 52 missouri	17.3 -90.72214	39.21896	27	7855
## 53 missouri	17.3 -90.72787	39.17885	27	7856
## 54 missouri	17.3 -90.72214	39.14448	27	7857
## 55 missouri	17.3 -90.69922	39.11010	27	7858
## 56 missouri	17.3 -90.71641	39.05280	27	7859
## 57 missouri	17.3 -90.69922	38.99551	27	7860
## 58 missouri	17.3 -90.67630	38.93821	27	7861
## 59 missouri	17.3 -90.67057	38.91529	27	7862
## 60 missouri	17.3 -90.63619	38.88092	27	7863
## 61 missouri	17.3 -90.60181	38.85800	27	7864
## 62 missouri	17.3 -90.56744	38.86946	27	7865
## 63 missouri	17.3 -90.54452	38.88664	27	7866
## 64 missouri	17.3 -90.49295	38.92675	27	7867
## 65 missouri	17.3 -90.45284	38.96113	27	7868
## 66 missouri	17.3 -90.40701	38.94967	27	7869
## 67 missouri	17.3 -90.37263	38.94394	27	7870
## 68 missouri	17.3 -90.31534	38.92675	27	7871
## 69 missouri	17.3 -90.26950	38.92675	27	7872
## 70 missouri	17.3 -90.24085	38.92102	27	7873
## 71 missouri	17.3 -90.18929	38.88664	27	7874
## 72 missouri	17.3 -90.14345	38.85800	27	7875
## 73 missouri	17.3 -90.12054	38.82935	27	7876
## 74 missouri	17.3 -90.12054	38.80070	27	7877
## 75 missouri	17.3 -90.14345	38.77778	27	7878
## 76 missouri	17.3 -90.17783	38.77205	27	7879
## 77 missouri	17.3 -90.18929	38.73768	27	7880
## 78 missouri	17.3 -90.19501	38.68611	27	7881
## 79 missouri	17.3 -90.18356	38.65173	27	7882
## 80 missouri	17.3 -90.18356	38.61736	27	7883
## 81 missouri	17.3 -90.20075	38.58298	27	7884
## 82 missouri	17.3 -90.24658	38.54287	27	7885
## 83 missouri	17.3 -90.26377	38.50276	27	7886
## 84 missouri	17.3 -90.30388	38.42828	27	7887
## 85 missouri	17.3 -90.34399	38.40536	27	7888
## 86 missouri	17.3 -90.36691	38.38244	27	7889
## 87 missouri	17.3 -90.39555	38.33088	27	7890
## 88 missouri	17.3 -90.37836	38.24493	27	7891
## 89 missouri	17.3 -90.37263	38.21629	27	7892
## 90 missouri	17.3 -90.30388	38.17045	27	7893
## 91 missouri	17.3 -90.25231	38.11888	27	7894
## 92 missouri	17.3 -90.20647	38.08450	27	7895
## 93 missouri	17.3 -90.19501	38.07878	27	7896
## 94 missouri	17.3 -90.16064	38.07304	27	7897
## 95 missouri	17.3 -90.12054	38.02721	27	7898
## 96 missouri	17.3 -90.00021	37.96991	27	7899
## 97 missouri	17.3 -89.95438	37.96991	27	7900
## 98 missouri	17.3 -89.93719	37.96991	27	7901
## 99 missouri	17.3 -89.94292	37.95272	27	7902
## 100 missouri	17.3 -89.98302	37.93554	27	7903
## 101 missouri	17.3 -89.98302	37.91835	27	7904
## 102 missouri	17.3 -89.93146	37.89543	27	7905
## 103 missouri	17.3 -89.90281	37.87824	27	7906

## 104 missouri	17.3 -89.83978	37.88970	27	7907
## 105 missouri	17.3 -89.71946	37.82094	27	7908
## 106 missouri	17.3 -89.67362	37.80376	27	7909
## 107 missouri	17.3 -89.65644	37.77511	27	7910
## 108 missouri	17.3 -89.64497	37.74646	27	7911
## 109 missouri	17.3 -89.54757	37.68916	27	7912
## 110 missouri	17.3 -89.51319	37.67198	27	7913
## 111 missouri	17.3 -89.50174	37.64906	27	7914
## 112 missouri	17.3 -89.51893	37.58030	27	7915
## 113 missouri	17.3 -89.51893	37.56311	27	7916
## 114 missouri	17.3 -89.50746	37.53447	27	7917
## 115 missouri	17.3 -89.44444	37.43706	27	7918
## 116 missouri	17.3 -89.42152	37.37977	27	7919
## 117 missouri	17.3 -89.43298	37.36258	27	7920
## 118 missouri	17.3 -89.47309	37.33393	27	7921
## 119 missouri	17.3 -89.50746	37.31674	27	7922
## 120 missouri	17.3 -89.51319	37.28809	27	7923
## 121 missouri	17.3 -89.50174	37.27090	27	7924
## 122 missouri	17.3 -89.46735	37.25945	27	7925
## 123 missouri	17.3 -89.45590	37.21934	27	7926
## 124 missouri	17.3 -89.44444	37.17923	27	7927
## 125 missouri	17.3 -89.40434	37.14485	27	7928
## 126 missouri	17.3 -89.39288	37.11621	27	7929
## 127 missouri	17.3 -89.38715	37.08183	27	7930
## 128 missouri	17.3 -89.35277	37.04172	27	7931
## 129 missouri	17.3 -89.32985	37.01880	27	7932
## 130 missouri	17.3 -89.30120	37.00734	27	7933
## 131 missouri	17.3 -89.27828	37.00734	27	7934
## 132 missouri	17.3 -89.26109	37.02453	27	7935
## 133 missouri	17.3 -89.28401	37.05891	27	7936
## 134 missouri	17.3 -89.28974	37.08756	27	7937
## 135 missouri	17.3 -89.26682	37.09329	27	7938
## 136 missouri	17.3 -89.24390	37.07037	27	7939
## 137 missouri	17.3 -89.19807	37.03026	27	7940
## 138 missouri	17.3 -89.17515	37.00161	27	7941
## 139 missouri	17.3 -89.13504	36.99588	27	7942
## 140 missouri	17.3 -89.10639	36.98442	27	7943
## 141 missouri	17.3 -89.08348	36.96724	27	7944
## 142 missouri	17.3 -89.08921	36.96724	27	7945
## 143 missouri	17.3 -89.08921	36.92713	27	7946
## 144 missouri	17.3 -89.08921	36.89275	27	7947
## 145 missouri	17.3 -89.14077	36.84119	27	7948
## 146 missouri	17.3 -89.14650	36.81254	27	7949
## 147 missouri	17.3 -89.13504	36.80681	27	7950
## 148 missouri	17.3 -89.11213	36.78962	27	7951
## 149 missouri	17.3 -89.11213	36.77243	27	7952
## 150 missouri	17.3 -89.10639	36.74379	27	7953
## 151 missouri	17.3 -89.11213	36.74379	27	7954
## 152 missouri	17.3 -89.12932	36.70940	27	7955
## 153 missouri	17.3 -89.14650	36.67503	27	7956
## 154 missouri	17.3 -89.15223	36.67503	27	7957
## 155 missouri	17.3 -89.16370	36.65211	27	7958

## 156 missouri	17.3	-89.16943	36.62919	27	7959
## 157 missouri	17.3	-89.16943	36.58335	27	7960
## 158 missouri	17.3	-89.19234	36.57190	27	7961
## 159 missouri	17.3	-89.22099	36.56617	27	7962
## 160 missouri	17.3	-89.24964	36.57763	27	7963
## 161 missouri	17.3	-89.29548	36.61773	27	7964
## 162 missouri	17.3	-89.32985	36.64065	27	7965
## 163 missouri	17.3	-89.40434	36.50314	27	7966
## 164 missouri	17.3	-89.43298	36.47449	27	7967
## 165 missouri	17.3	-89.45017	36.45731	27	7968
## 166 missouri	17.3	-89.47882	36.47449	27	7969
## 167 missouri	17.3	-89.46735	36.53752	27	7970
## 168 missouri	17.3	-89.47882	36.56617	27	7971
## 169 missouri	17.3	-89.51893	36.58335	27	7972
## 170 missouri	17.3	-89.54757	36.57763	27	7973
## 171 missouri	17.3	-89.55903	36.54898	27	7974
## 172 missouri	17.3	-89.53612	36.53752	27	7975
## 173 missouri	17.3	-89.51319	36.52033	27	7976
## 174 missouri	17.3	-89.51319	36.50314	27	7977
## 175 missouri	17.3	-89.54185	36.48595	27	7978
## 176 missouri	17.3	-89.54757	36.44011	27	7979
## 177 missouri	17.3	-89.50746	36.38855	27	7980
## 178 missouri	17.3	-89.51893	36.37136	27	7981
## 179 missouri	17.3	-89.53612	36.35990	27	7982
## 180 missouri	17.3	-89.56477	36.36563	27	7983
## 181 missouri	17.3	-89.58768	36.34844	27	7984
## 182 missouri	17.3	-89.60487	36.34271	27	7985
## 183 missouri	17.3	-89.61060	36.32552	27	7986
## 184 missouri	17.3	-89.55330	36.27969	27	7987
## 185 missouri	17.3	-89.55330	36.26250	27	7988
## 186 missouri	17.3	-89.57050	36.24531	27	7989
## 187 missouri	17.3	-89.61060	36.25677	27	7990
## 188 missouri	17.3	-89.66217	36.26250	27	7991
## 189 missouri	17.3	-89.68508	36.23385	27	7992
## 190 missouri	17.3	-89.67362	36.21666	27	7993
## 191 missouri	17.3	-89.61060	36.18801	27	7994
## 192 missouri	17.3	-89.59914	36.17082	27	7995
## 193 missouri	17.3	-89.60487	36.14218	27	7996
## 194 missouri	17.3	-89.62778	36.09634	27	7997
## 195 missouri	17.3	-89.65070	36.06197	27	7998
## 196 missouri	17.3	-89.68508	36.06197	27	7999
## 197 missouri	17.3	-89.70801	36.03331	27	8000
## 198 missouri	17.3	-89.71946	36.00467	27	8001
## 199 missouri	17.3	-89.75384	36.00467	27	8002
## 200 missouri	17.3	-89.79395	36.00467	27	8003
## 201 missouri	17.3	-89.96583	36.00467	27	8004
## 202 missouri	17.3	-89.97157	35.99894	27	8005
## 203 missouri	17.3	-90.29815	35.99894	27	8006
## 204 missouri	17.3	-90.38409	36.00467	27	8007
## 205 missouri	17.3	-90.37836	36.00467	27	8008
## 206 missouri	17.3	-90.26377	36.13072	27	8009
## 207 missouri	17.3	-90.18929	36.17656	27	8010

## 208 missouri	17.3	-90.18929	36.19947	27	8011
## 209 missouri	17.3	-90.13772	36.21666	27	8012
## 210 missouri	17.3	-90.12054	36.27396	27	8013
## 211 missouri	17.3	-90.09188	36.28542	27	8014
## 212 missouri	17.3	-90.06897	36.34844	27	8015
## 213 missouri	17.3	-90.06897	36.38855	27	8016
## 214 missouri	17.3	-90.10334	36.40001	27	8017
## 215 missouri	17.3	-90.12626	36.40574	27	8018
## 216 missouri	17.3	-90.13772	36.47449	27	8019
## 217 missouri	17.3	-90.17210	36.50314	27	8020
## 218 missouri	17.3	-90.22366	36.50887	27	8021
## 219 missouri	17.3	-90.57317	36.50887	27	8022
## 220 missouri	17.3	-90.79089	36.50314	27	8023
## 221 missouri	17.3	-91.14613	36.50314	27	8024
## 222 missouri	17.3	-91.41541	36.50314	27	8025
## 223 missouri	17.3	-91.42114	36.49741	27	8026
## 224 missouri	17.3	-91.46125	36.49741	27	8027
## 225 missouri	17.3	-91.46698	36.49741	27	8028
## 226 missouri	17.3	-91.67325	36.50314	27	8029
## 227 missouri	17.3	-92.13161	36.49741	27	8030
## 228 missouri	17.3	-92.16026	36.49741	27	8031
## 229 missouri	17.3	-92.54987	36.50314	27	8032
## 230 missouri	17.3	-92.76759	36.50314	27	8033
## 231 missouri	17.3	-92.77332	36.50314	27	8034
## 232 missouri	17.3	-92.84208	36.50314	27	8035
## 233 missouri	17.3	-92.84781	36.50314	27	8036
## 234 missouri	17.3	-93.30045	36.49741	27	8037
## 235 missouri	17.3	-93.30618	36.50314	27	8038
## 236 missouri	17.3	-93.32336	36.49741	27	8039
## 237 missouri	17.3	-93.33482	36.50314	27	8040
## 238 missouri	17.3	-93.59265	36.49741	27	8041
## 239 missouri	17.3	-93.59839	36.50314	27	8042
## 240 missouri	17.3	-93.87341	36.49741	27	8043
## 241 missouri	17.3	-93.89059	36.50314	27	8044
## 242 missouri	17.3	-94.07967	36.49741	27	8045
## 243 missouri	17.3	-94.08540	36.50314	27	8046
## 244 missouri	17.3	-94.62398	36.50887	27	8047
## 245 missouri	17.3	-94.63544	36.68649	27	8048
## 246 missouri	17.3	-94.62971	36.78389	27	8049
## 247 missouri	17.3	-94.63544	37.01308	27	8050
## 248 missouri	17.3	-94.63544	37.02453	27	8051
## 249 missouri	17.3	-94.63544	37.06464	27	8052
## 250 missouri	17.3	-94.63544	37.34539	27	8053
## 251 missouri	17.3	-94.62971	37.37404	27	8054
## 252 missouri	17.3	-94.62971	37.65479	27	8055
## 253 missouri	17.3	-94.62971	37.67770	27	8056
## 254 missouri	17.3	-94.62398	38.04440	27	8057
## 255 missouri	17.3	-94.62398	38.06159	27	8058
## 256 missouri	17.3	-94.61252	38.39390	27	8059
## 257 missouri	17.3	-94.61825	38.47984	27	8060
## 258 missouri	17.3	-94.61252	38.73768	27	8061
## 259 missouri	17.3	-94.61825	38.84654	27	8062

## 260 missouri	17.3	-94.61252	39.05280	27	8063
## 261 missouri	17.3	-94.59534	39.13874	27	8064
## 262 missouri	17.3	-94.58387	39.15593	27	8065
## 263 missouri	17.3	-94.60680	39.15593	27	8066
## 264 missouri	17.3	-94.64117	39.16740	27	8067
## 265 missouri	17.3	-94.68127	39.19604	27	8068
## 266 missouri	17.3	-94.73284	39.17885	27	8069
## 267 missouri	17.3	-94.76722	39.19604	27	8070
## 268 missouri	17.3	-94.81306	39.21323	27	8071
## 269 missouri	17.3	-94.85889	39.27626	27	8072
## 270 missouri	17.3	-94.89327	39.33355	27	8073
## 271 missouri	17.3	-94.89327	39.38512	27	8074
## 272 missouri	17.3	-94.93910	39.40231	27	8075
## 273 missouri	17.3	-94.95630	39.42522	27	8076
## 274 missouri	17.3	-94.98494	39.46533	27	8077
## 275 missouri	17.3	-95.06516	39.50544	27	8078
## 276 missouri	17.3	-95.11099	39.53982	27	8079
## 277 missouri	17.3	-95.11099	39.55701	27	8080
## 278 missouri	17.3	-95.07661	39.60284	27	8081
## 279 missouri	17.3	-95.05943	39.63722	27	8082
## 280 missouri	17.3	-95.03651	39.67160	27	8083
## 281 missouri	17.3	-94.97921	39.71170	27	8084
## 282 missouri	17.3	-94.97921	39.75181	27	8085
## 283 missouri	17.3	-94.91046	39.75181	27	8086
## 284 missouri	17.3	-94.87035	39.75754	27	8087
## 285 missouri	17.3	-94.92765	39.78619	27	8088
## 286 missouri	17.3	-94.89327	39.79765	27	8089
## 287 missouri	17.3	-94.88754	39.83203	27	8090
## 288 missouri	17.3	-94.89327	39.86641	27	8091
## 289 missouri	17.3	-94.95056	39.87214	27	8092
## 290 missouri	17.3	-94.97921	39.92943	27	8093
## 291 missouri	17.3	-95.00214	39.91224	27	8094
## 292 missouri	17.3	-95.02505	39.90651	27	8095
## 293 missouri	17.3	-95.04797	39.88359	27	8096
## 294 missouri	17.3	-95.12818	39.87214	27	8097
## 295 missouri	17.3	-95.17975	39.91224	27	8098
## 296 missouri	17.3	-95.22559	39.94089	27	8099
## 297 missouri	17.3	-95.24850	39.96954	27	8100
## 298 missouri	17.3	-95.30007	40.00964	27	8101
## 299 missouri	17.3	-95.33445	40.02110	27	8102
## 300 missouri	17.3	-95.34018	40.02110	27	8103
## 301 missouri	17.3	-95.40320	40.07840	27	8104
## 302 missouri	17.3	-95.39174	40.12423	27	8105
## 303 missouri	17.3	-95.41467	40.18153	27	8106
## 304 missouri	17.3	-95.46623	40.21018	27	8107
## 305 missouri	17.3	-95.48341	40.26175	27	8108
## 306 missouri	17.3	-95.53498	40.27320	27	8109
## 307 missouri	17.3	-95.56363	40.30758	27	8110
## 308 missouri	17.3	-95.63239	40.32477	27	8111
## 309 missouri	17.3	-95.62093	40.38206	27	8112
## 310 missouri	17.3	-95.64384	40.43936	27	8113
## 311 missouri	17.3	-95.68968	40.50239	27	8114

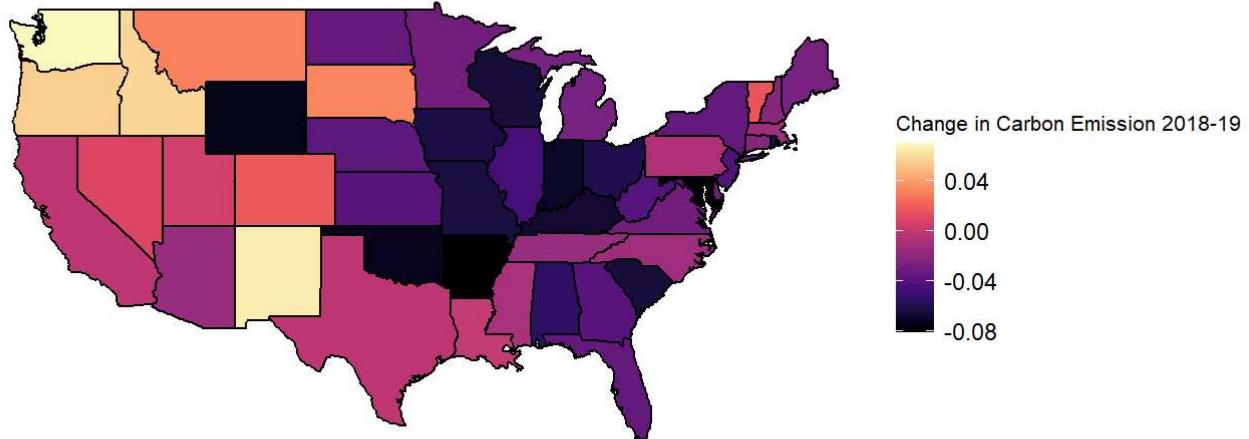
```
## 312 missouri      17.3 -95.71833 40.53104    27  8115
## 313 missouri      17.3 -95.75271 40.55968    27  8116
## 314 missouri      17.3 -95.76416 40.59406    27  8117
## 315 missouri      17.3 -95.75271 40.61125    27  8118
```

Data Visualization

Mapping

```
## mapping change in carbon emissions 2018-19
pct_emission_change_map <- ggplot(state_final_df_2018, aes(x=long, y=lat)) +
  geom_polygon(aes(group=group, fill = pct_change), color="yellow") +
  scale_fill_viridis(option="magma") +
  geom_polygon(data = state_map_data, aes(group=group), color = "black", fill = NA) +
  theme_void() + coord_quickmap() +
  labs(fill = "Change in Carbon Emission 2018-19") +
  theme(plot.margin = margin(0.5, 0.5, 0.5, 0.5, "cm"),
        legend.title = element_text(size = 8),
        legend.key.size = unit(0.5, "cm")) +
  theme(plot.background = element_rect(fill = "white"))

pct_emission_change_map
```

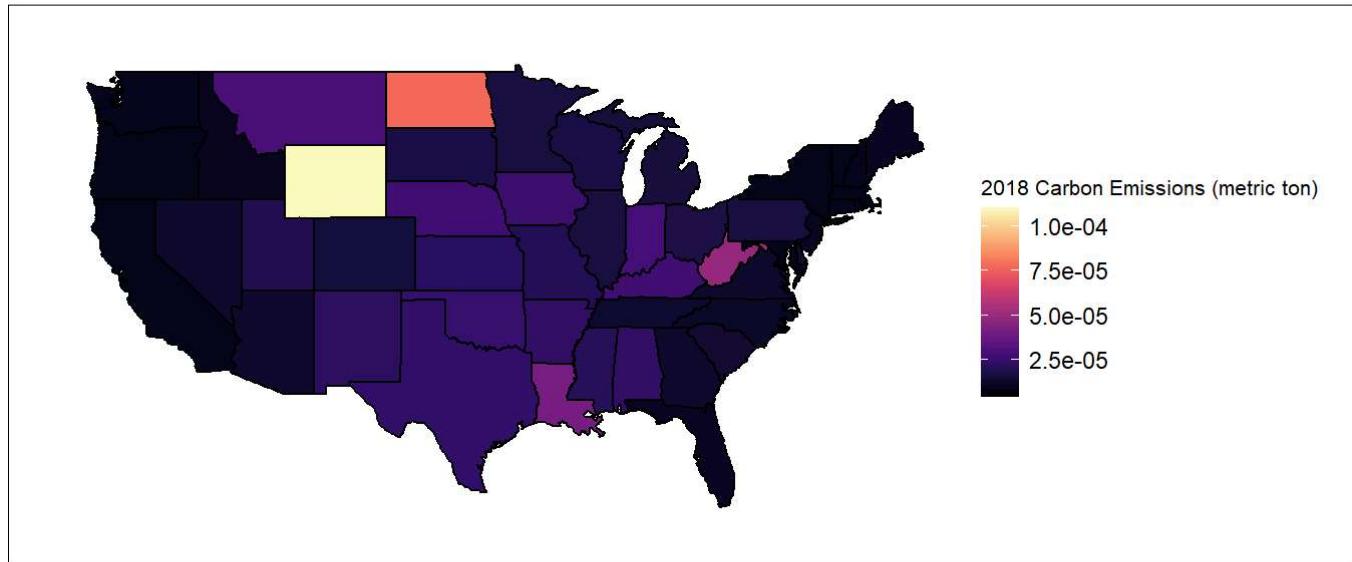


```
ggsave("pct_emission_change_map.png", pct_emission_change_map)
```

```
## Saving 7 x 5 in image
```

```
## mapping 2018 carbon emissions
emission_map_2018 <- ggplot(state_final_df_2018, aes(x=long, y=lat)) +
  geom_polygon(aes(group=group, fill = std_2018_emission), color="yellow") +
  scale_fill_viridis(option="magma") +
  geom_polygon(data = state_map_data, aes(group=group), color = "black", fill = NA) +
  theme_void() + coord_quickmap() +
  labs(fill = "2018 Carbon Emissions (metric ton)") +
  theme(plot.margin = margin(0.5, 0.5, 0.5, 0.5, "cm"),
        legend.title = element_text(size = 8),
        legend.key.size = unit(0.5, "cm")) +
  theme(plot.background = element_rect(fill = "white"))

emission_map_2018
```

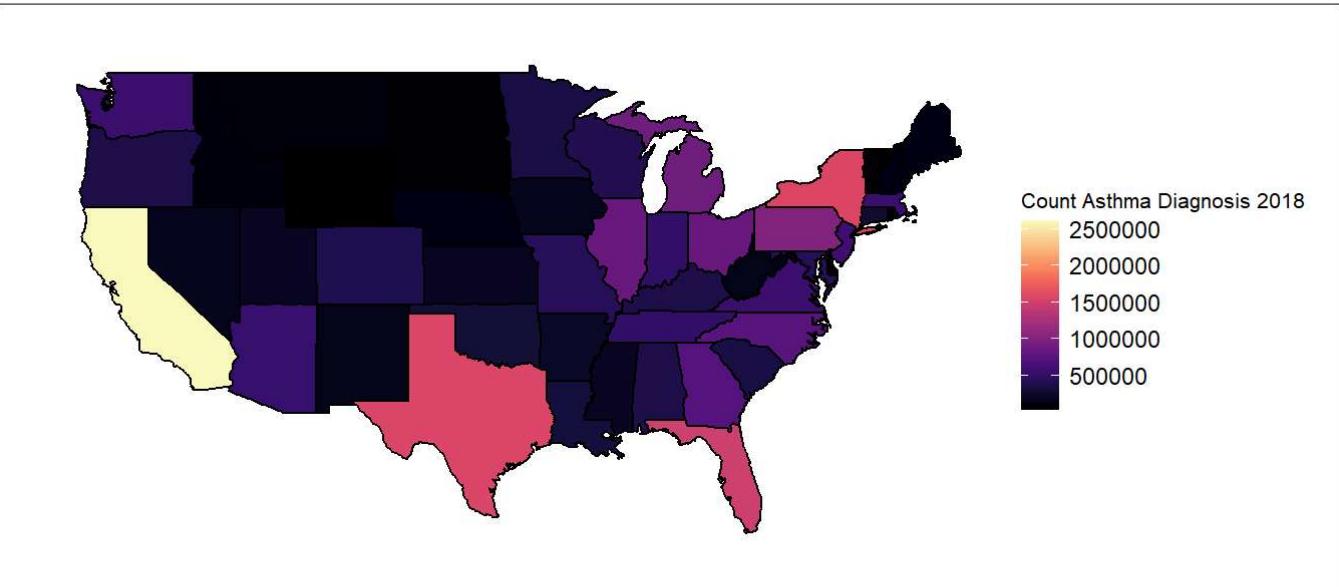


```
ggsave("emission_map_2018.png", emission_map_2018)
```

```
## Saving 7 x 5 in image
```

```
## raw asthma diagnosis 2018
asthma_population_2018_map <- ggplot(state_final_df_2018, aes(x=long, y=lat)) +
  geom_polygon(aes(group=group, fill = asthma_population), color="yellow") +
  scale_fill_viridis(option="magma") +
  geom_polygon(data = state_map_data, aes(group=group), color = "black", fill = NA) +
  theme_void() + coord_quickmap() +
  labs(fill = "Count Asthma Diagnosis 2018") +
  theme(plot.margin = margin(0.5, 0.5, 0.5, 0.5, "cm"),
        legend.title = element_text(size = 8),
        legend.key.size = unit(0.5, "cm")) +
  theme(plot.background = element_rect(fill = "white"))

asthma_population_2018_map
```

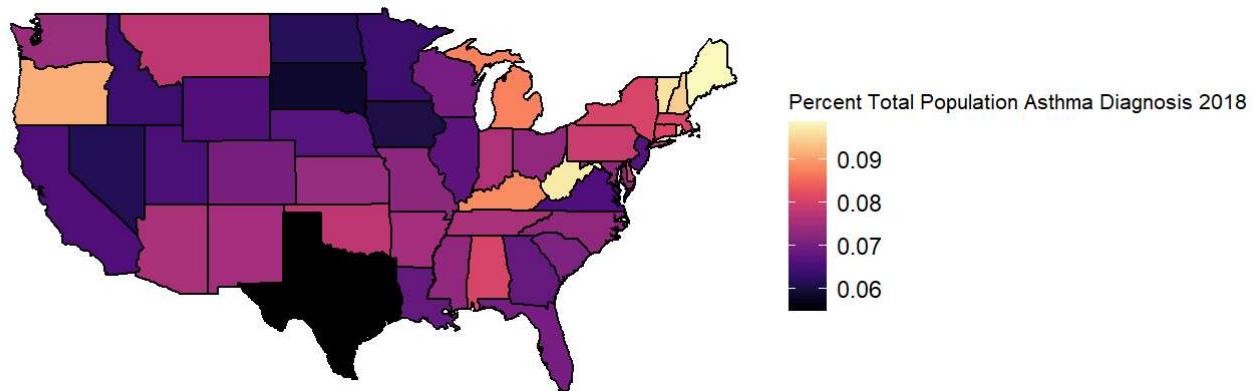


```
ggsave("asthma_population_2018_map.png", asthma_population_2018_map)
```

```
## Saving 7 x 5 in image
```

```
## pct population w/ asthma 2018
pct_asthma_2018_map <- ggplot(state_final_df_2018, aes(x=long, y=lat)) +
  geom_polygon(aes(group=group, fill = pct_asthma_population), color="yellow") +
  scale_fill_viridis(option="magma") +
  geom_polygon(data = state_map_data, aes(group=group), color = "black", fill = NA) +
  theme_void() + coord_quickmap() +
  labs(fill = "Percent Total Population Asthma Diagnosis 2018") +
  theme(plot.margin = margin(0.5, 0.5, 0.5, 0.5, "cm"),
        legend.title = element_text(size = 8),
        legend.key.size = unit(0.5, "cm")) +
  theme(plot.background = element_rect(fill = "white"))

pct_asthma_2018_map
```



```
ggsave("pct_asthma_2018_map.png", pct_asthma_2018_map)
```

```
## Saving 7 x 5 in image
```

Creating Asthma Summary

```
## asthma 2018 df
asthma_2018 <- left_join(state_asthma_2018, state_population_2018, by = c("state"))

asthma_2018 <- asthma_2018 %>%
  mutate(pct_population = c(asthma_population)/c(total_population)) %>%
  mutate(state = str_to_title(state))

asthma_2018$state <- replace(asthma_2018$state, asthma_2018$state=="District Of Columbia", "District of Columbia")

head(asthma_2018)
```

	state	asthma_population	total_population	pct_population
## 1	Alabama	394634	4887871	0.08073740
## 2	Alaska	50685	737438	0.06873120
## 3	Arizona	545104	7171646	0.07600821
## 4	Arkansas	225853	3013825	0.07493899
## 5	California	2607598	39557045	0.06591994
## 6	Colorado	399357	5695564	0.07011720

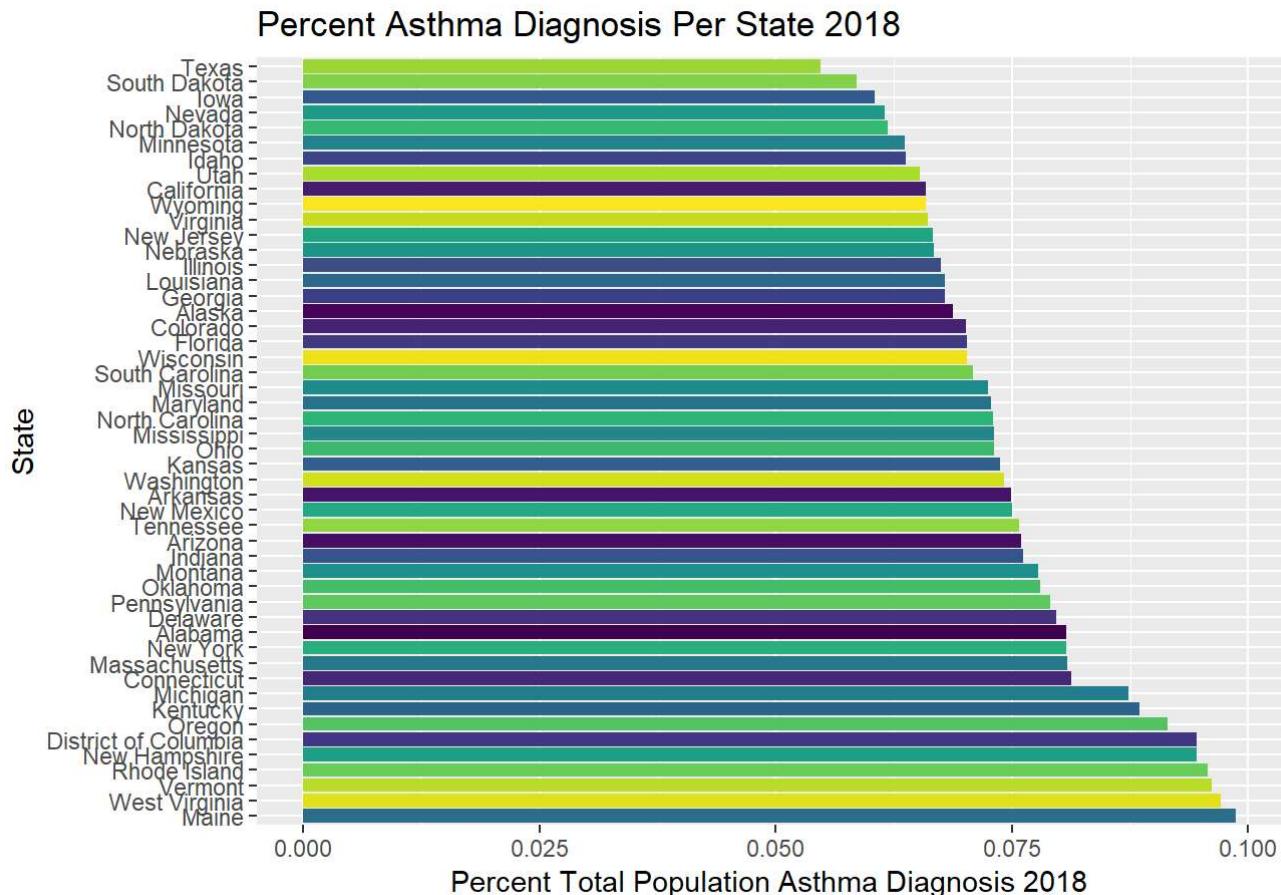
```
summary(asthma_2018)
```

	state	asthma_population	total_population	pct_population
## Length:50		Min. : 38099	Min. : 577737	Min. : 0.05480
## Class :character		1st Qu.: 138389	1st Qu.: 1836691	1st Qu.: 0.06694
## Mode :character		Median : 358793	Median : 4564190	Median : 0.07307
##		Mean : 466329	Mean : 6514939	Mean : 0.07495
##		3rd Qu.: 558822	3rd Qu.: 7444605	3rd Qu.: 0.08047
##		Max. : 2607598	Max. : 39557045	Max. : 0.09872

Asthma Data Visualization

```
## horizontal bar graph
asthma_bar_2018 <- ggplot(asthma_2018, aes(y = fct_reorder(state, pct_population) %>% fct_rev(),
x = pct_population, fill = state))+
  geom_col() +
  scale_fill_viridis(discrete = TRUE) +
  theme(legend.position = "none",
        plot.margin = margin(0.5, 0.5, 0.5, 0.5, "cm")) +
  labs(title = "Percent Asthma Diagnosis Per State 2018",
       x = "Percent Total Population Asthma Diagnosis 2018",
       y = "State")

asthma_bar_2018
```



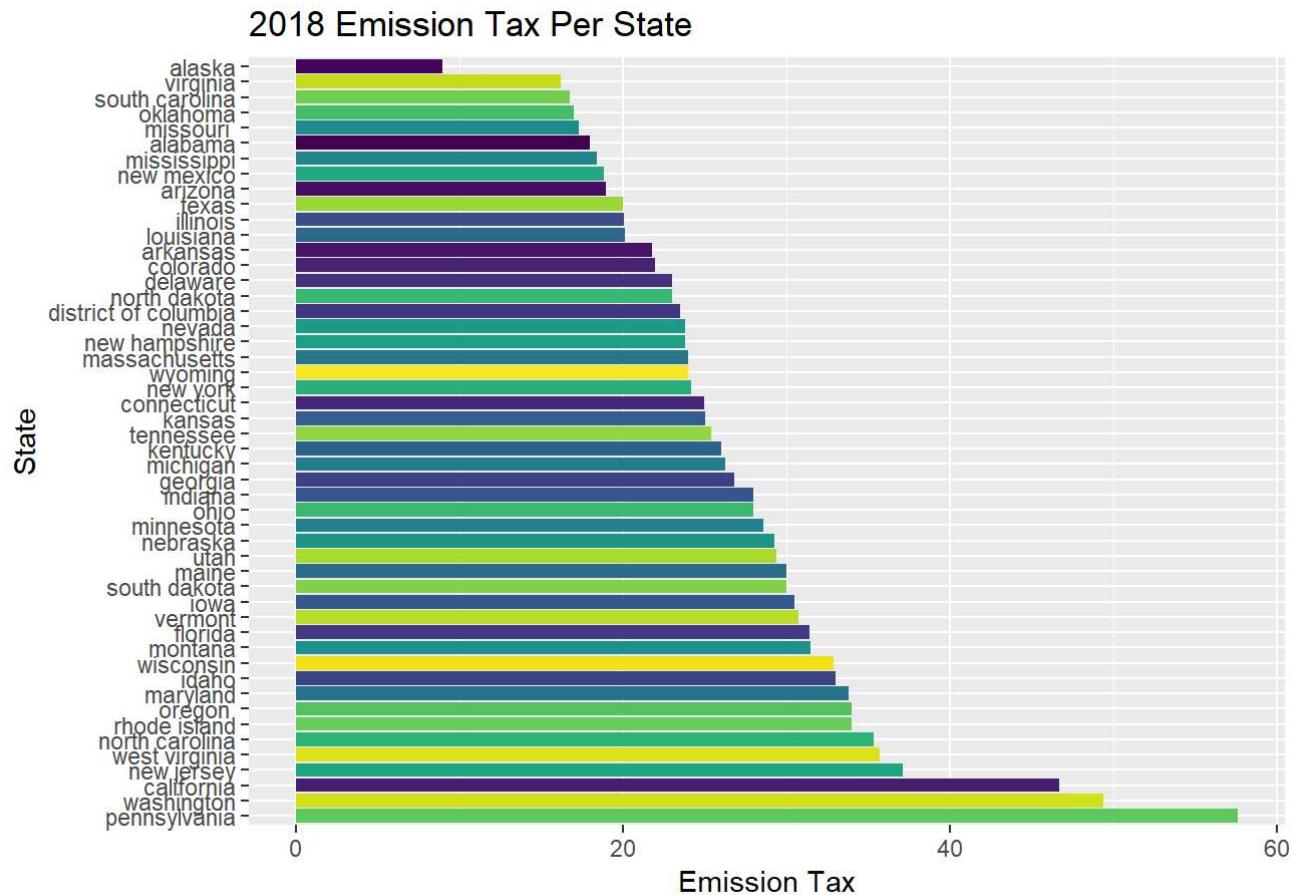
```
ggsave("asthma_bar_2018.png", asthma_bar_2018, height = 8)
```

```
## Saving 7 x 8 in image
```

Emission Data Visualization

```
## 2018 emission tax histogram
state_tax_bar_2018 <- ggplot(state_tax_2018,
  aes(y=fct_reorder(state, emission_tax) %>% fct_rev(),
      x = emission_tax, fill = state)) +
  geom_col() + scale_fill_viridis(discrete = TRUE) +
  theme(legend.position = "none",
        plot.margin = margin(0.5, 0.5, 0.5, 0.5, "cm")) +
  labs(title = "2018 Emission Tax Per State",
       x = "Emission Tax",
       y = "State")

state_tax_bar_2018
```



```
ggsave("state_tax_bar_2018.png", state_tax_bar_2018, height = 8)
```

```
## Saving 7 x 8 in image
```

Creating Emission Summary

```

## preparing 2018 emission data
state_emission_2018 <- state_emission_df %>%
  filter(year == c("2018")) %>%
  pivot_wider(names_from = year, values_from = carbon_emission) %>%
  rename("avg_2018_emission" = "2018")

## joining emission w/ population data
state_emission_2018 <- left_join(state_emission_2018, state_population_2018, by = c("state"))

## making emission per capita variable
state_emission_2018 <- state_emission_2018 %>%
  mutate(emission_per_capita = c(avg_2018_emission)/c(total_population)) %>%
  mutate(state = str_to_title(state)) %>%
  filter(!(state == c("Hawaii")))

## standardizing variables
state_emission_2018 $state <- replace(state_emission_2018$state, state_emission_2018$state=="District Of Columbia", "District of Columbia")

head(state_emission_2018)

```

```

## # A tibble: 6 × 4
##   state      avg_2018_emission total_population emission_per_capita
##   <chr>          <dbl>           <int>            <dbl>
## 1 Alabama        112.          4887871          0.0000230
## 2 Alaska         34.5          737438           0.0000468
## 3 Arizona        94.1          7171646          0.0000131
## 4 Arkansas       70.8          3013825          0.0000235
## 5 California     359.          39557045         0.00000907
## 6 Colorado       90.1          5695564           0.0000158

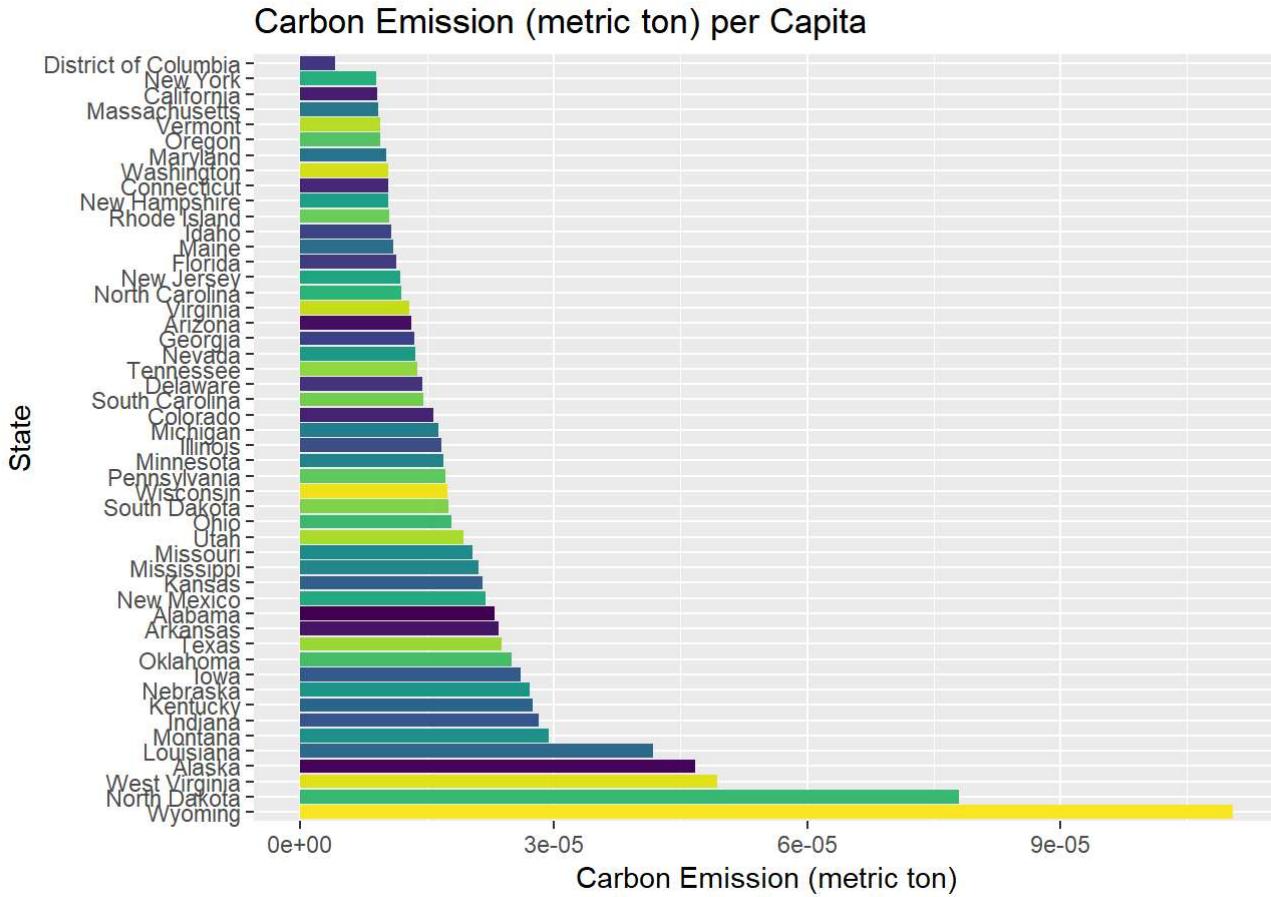
```

```
summary(state_emission_2018)
```

	state	avg_2018_emission	total_population	emission_per_capita
##	Length:50	Min. : 2.90	Min. : 577737	Min. :4.128e-06
##	Class :character	1st Qu.: 42.52	1st Qu.: 1836691	1st Qu.:1.113e-05
##	Mode :character	Median : 80.55	Median : 4564190	Median :1.655e-05
##		Mean :105.51	Mean : 6514939	Mean :2.112e-05
##		3rd Qu.:123.85	3rd Qu.: 7444605	3rd Qu.:2.337e-05
##		Max. :684.80	Max. :39557045	Max. :1.104e-04

Emission Data per Capita Visualization

```
## emission per capital horizontal bar graph
state_emission_2018_plot <- ggplot(state_emission_2018, aes(y=fct_reorder(state, emission_per_capita) %>% fct_rev(), x=emission_per_capita, fill = state))+  
  geom_col() +  
  scale_fill_viridis(discrete = TRUE) +  
  theme(legend.position = "none",  
        plot.margin = margin(0.5, 0.5, 0.5, 0.5, "cm")) +  
  labs(title = "Carbon Emission (metric ton) per Capita",  
       x = "Carbon Emission (metric ton)",  
       y = "State")  
  
state_emission_2018_plot
```



```
ggsave("state_emission_2018_plot.png", state_emission_2018_plot, height = 8)
```

```
## Saving 7 x 8 in image
```