LAs BEST Project

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Note that the `echo = FALSE` parameter was added to the code chunk to prevent printing of the R code that generated the plot.

```
getwd()
```

```
## [1] "C:/Users/josep/OneDrive/Desktop/LA's BeST Research Project/Github/EV Project"
```

```
EV_data <- read.csv("./Data/data_ZEV_asthmaED_2013_2022.csv")
```

```
#Getting number of EVs per 1000 people
EV_data$nZEV1000pop <- EV_data$nZEV/EV_data$pop *1000
#RoA = Rate of Asthma
EV_data$log_AgeAdj_RoA_ED_Visit_Rate <- log(EV_data$Age_Adjusted_Rate_of_Asthma_ED_Visit_Rate)
#Getting LN to help create better plots
```

```
#Summary Stats by all years
summary_stats_allyrs <- c(
summary(EV_data$Age_Adjusted_Rate_of_Asthma_ED_Visit_Rate),
SD=sd(EV_data$Age_Adjusted_Rate_of_Asthma_ED_Visit_Rate))

summary_stats_allyrs
```

```
##      Min.   1st Qu.    Median      Mean   3rd Qu.      Max.        SD
##   2.90000  22.50000  34.90000  41.90313  52.60000 669.30000  28.98692
```

```
#mean(41.90) --> #there are about 41.90 visits to ED per 10,000ppl
#Sd(28.98) --> there is huge variance between zip codes and ppl in ED
```

```
sum(is.na(EV_data))
```

```
## [1] 0
```

```
#Summary Stats by each years
cat("Summary Statistics of Asthma ED Visit Rates by Year:\n")
```

```
## Summary Statistics of Asthma ED Visit Rates by Year:
```

```r
print(tapply(EV_data$Age_Adjusted_Rate_of_Asthma_ED_Visit_Rate, EV_data$yr, summary, na.rm = TRUE))
```

```
## $`2013`
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##    7.60   28.20   42.85   49.51   60.98  278.10
##
## $`2014`
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##    7.00   28.00   43.75   49.69   61.42  252.20
##
## $`2015`
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##    6.80   29.40   45.20   51.45   64.60  323.40
##
## $`2016`
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##    5.80   26.50   39.10   46.30   58.05  358.90
##
## $`2017`
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##    5.80   27.30   41.40   48.63   59.30  669.30
##
## $`2018`
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##    6.50   23.95   37.20   43.27   52.75  311.30
##
## $`2019`
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##    6.80   23.90   37.40   43.03   53.17  350.40
##
## $`2020`
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##    2.90   14.40   21.90   25.63   31.60  210.30
##
## $`2021`
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##    3.20   14.60   21.20   25.38   30.90  172.60
##
## $`2022`
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##    5.70   20.00   28.90   32.57   39.90  204.80
```

```r
cat("\nStandard Deviation by Year:\n")
```

```
##
## Standard Deviation by Year:
```

```r
print(tapply(EV_data$Age_Adjusted_Rate_of_Asthma_ED_Visit_Rate , EV_data$yr , sd, na.rm = TRUE))
```

```
##     2013     2014     2015     2016     2017     2018     2019     2020
## 30.54874 30.64675 31.89268 29.60630 34.83508 28.00668 27.49992 17.14249
##     2021     2022
## 16.86820 18.16043
```

```r
tapply(EV_data$nZEV, EV_data$yr, summary, na.rm = TRUE)
```

```
## $`2013`
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##    0.00    5.75   21.00   42.55   55.00  489.00
##
## $`2014`
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##    0.00   14.00   48.00   88.41  119.00 1031.00
##
## $`2015`
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##     0.0    21.0    76.0   134.5   182.0  1612.0
##
## $`2016`
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##     0.0    33.0   111.0   187.9   258.0  2061.0
##
## $`2017`
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##     0.0    51.0   165.0   264.8   368.2  2627.0
##
## $`2018`
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##     0.0    74.5   236.0   373.8   520.0  3592.0
##
## $`2019`
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##     0.0   103.0   306.5   466.1   647.0  4153.0
##
## $`2020`
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##     1.0   146.0   381.0   544.1   764.0  4180.0
##
## $`2021`
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##     1.0   212.5   534.0   716.8  1021.5  4743.0
##
## $`2022`
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##     1.0   262.0   701.0   931.4  1317.0  6913.0
```

```r
tapply(EV_data$nZEV, EV_data$yr, sd,      na.rm = TRUE)
```

```
##      2013      2014      2015      2016      2017      2018      2019      2020
##  59.14079 113.51789 170.70389 231.28399 309.07842 427.45095 515.11476 562.29624
##      2021      2022
## 693.50239 915.31649
```

```r
tapply(EV_data$nZEV1000pop , EV_data$yr, summary, na.rm = TRUE)
```

```
## $`2013`
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##  0.0000  0.2376  0.6575  1.4236  1.8277 19.6846
##
## $`2014`
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##  0.0000  0.5902  1.5740  2.8940  3.9506 25.6807
##
## $`2015`
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##  0.0000  0.8642  2.5219  4.4183  5.9540 38.9570
##
## $`2016`
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##   0.000   1.347   3.593   6.087   8.174  51.788
##
## $`2017`
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##   0.000   2.049   5.366   8.668  12.182  67.299
##
## $`2018`
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##   0.000   2.965   7.768  12.103  16.944  91.312
##
## $`2019`
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##   0.000   3.941   9.961  14.721  20.482 101.309
##
## $`2020`
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##   0.190   4.868  11.445  15.982  22.439  98.538
##
## $`2021`
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##   0.386   7.141  15.822  20.928  29.400 135.695
##
## $`2022`
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##   0.386   9.738  21.961  28.464  39.254 245.957
```

```
tapply(EV_data$nZEV1000pop , EV_data$yr, sd,      na.rm = TRUE)
```

```
##      2013      2014      2015      2016      2017      2018      2019      2020
##  2.042576  3.587522  5.352172  7.063109  9.509201 12.952706 14.702309 14.870094
##      2021      2022
## 18.269126 25.380152
```

```
tapply(EV_data$pop , EV_data$yr, summary, na.rm = TRUE)
```

```
## $`2013`
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##     702   16580   30951   33023   45452  111165
##
## $`2014`
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##    1281   16580   30951   33013   45452  111165
##
## $`2015`
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##     702   16258   30611   32681   45231  111165
##
## $`2016`
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##    1246   16413   30787   32931   45440  111165
##
## $`2017`
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##    1159   16270   30714   32709   45163  111165
##
## $`2018`
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##    1246   16644   31000   33052   45461  111165
##
## $`2019`
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##    1289   16852   31179   33232   45775  111165
##
## $`2020`
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##    1615   20666   33234   35487   47081  111165
##
## $`2021`
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##    1615   20670   33234   35491   47096  111165
##
## $`2022`
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##    1462   18591   31936   34067   46241  111165
```

```
tapply(EV_data$pop , EV_data$yr, sd,      na.rm = TRUE)
```

```
##     2013     2014     2015     2016     2017     2018     2019     2020
## 20795.99 20803.96 20943.63 20839.85 20918.00 20782.13 20753.63 20159.38
##     2021     2022
## 20182.61 20547.30
```

```
tapply(EV_data$percPoverty , EV_data$yr, summary, na.rm = TRUE)
```

```
## $`2013`
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##    0.00    7.40   11.45   13.64   18.02   56.70
##
## $`2014`
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##    0.00    7.40   11.45   13.68   17.93   56.70
##
## $`2015`
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##    0.00    7.40   11.50   13.74   18.10   56.70
##
## $`2016`
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##    0.00    7.40   11.50   13.71   18.10   56.70
##
## $`2017`
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##    0.00    7.40   11.50   13.69   18.10   49.40
##
## $`2018`
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##    0.00    7.40   11.50   13.67   18.05   49.40
##
## $`2019`
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##    0.00    7.40   11.50   13.78   18.18   56.70
##
## $`2020`
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##     0.0     7.5    11.6    13.8    18.2    49.4
##
## $`2021`
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##     0.0     7.5    11.6    13.8    18.2    56.7
##
## $`2022`
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##     0.0     7.5    11.6    13.7    18.1    49.4
```

```
tapply(EV_data$percPoverty , EV_data$yr, sd,      na.rm = TRUE)
```

```
##     2013     2014     2015     2016     2017     2018     2019     2020
## 8.515461 8.595512 8.556429 8.541994 8.505724 8.515091 8.597460 8.345641
##     2021     2022
## 8.366060 8.360286
```

```
tapply(EV_data$HHincomeMedian , EV_data$yr, summary, na.rm = TRUE)
```

```
## $`2013`
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##   14822   53904   73169   79830   97399  250000
##
## $`2014`
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##   14822   53927   73169   79676   97690  250000
##
## $`2015`
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##   14822   53647   72995   79531   97054  250000
##
## $`2016`
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##   14822   54039   73093   79732   97451  250000
##
## $`2017`
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##   14822   53927   73063   79771   97583  250000
##
## $`2018`
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##   14822   54039   73151   79986   97918  250000
##
## $`2019`
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##   14822   53804   73093   79391   97117  237841
##
## $`2020`
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##   14822   54167   72926   78597   96085  222930
##
## $`2021`
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##   14822   54139   72778   78621   95987  222930
##
## $`2022`
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##   14822   54110   73093   79370   97179  250000
```

```
tapply(EV_data$HHincomeMedian , EV_data$yr, sd,      na.rm = TRUE)
```

```
##     2013     2014     2015     2016     2017     2018     2019     2020
## 34407.73 33890.76 34193.40 34167.45 34396.12 34483.68 33634.67 32015.01
##     2021     2022
## 32190.08 33185.61
```

```
tapply(EV_data$HHincomeMean , EV_data$yr, summary, na.rm = TRUE)
```

```
## $`2013`
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##   28973   72494   93745  104685  126755  347939
##
## $`2014`
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##   28973   72676   93830  104482  126755  344838
##
## $`2015`
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##   28973   72082   93755  104552  126601  347939
##
## $`2016`
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##   28973   72595   93734  104509  126762  347939
##
## $`2017`
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##   28973   72386   93723  104548  126755  347939
##
## $`2018`
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##   28973   72595   93904  105042  126809  347939
##
## $`2019`
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##   28973   71918   93745  103864  125516  347939
##
## $`2020`
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##   28973   72298   93416  102113  124232  312860
##
## $`2021`
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##   28973   72357   93363  102219  124080  325745
##
## $`2022`
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##   28973   72520   93973  103515  125416  344838
```

```
tapply(EV_data$HHincomeMean , EV_data$yr, sd,      na.rm = TRUE)
```

```
##     2013     2014     2015     2016     2017     2018     2019     2020
## 46741.51 45815.85 46667.70 46040.89 46476.86 47218.44 45045.16 41329.46
##     2021     2022
## 41785.86 43532.31
```

```
tapply(EV_data$EDUCpercHSplus , EV_data$yr, summary, na.rm = TRUE)
```

```
## $`2013`
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##   28.90   77.20   87.70   83.57   93.40   99.40
##
## $`2014`
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##   28.90   77.28   87.70   83.63   93.40   99.70
##
## $`2015`
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##   28.90   77.15   87.70   83.51   93.35   99.70
##
## $`2016`
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##   28.90   77.10   87.50   83.45   93.30   99.20
##
## $`2017`
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##   28.90   77.28   87.70   83.64   93.40   99.70
##
## $`2018`
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##   28.90   77.25   87.70   83.61   93.40   99.70
##
## $`2019`
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##   28.90   77.10   87.45   83.41   93.30   99.70
##
## $`2020`
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##   28.90   76.70   86.80   82.96   92.90   98.70
##
## $`2021`
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##   28.90   76.70   86.70   82.95   92.95   99.40
##
## $`2022`
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##   28.90   77.10   87.20   83.35   93.10   99.40
```

```
tapply(EV_data$EDUCpercHSplus , EV_data$yr, sd,      na.rm = TRUE)
```

```
##     2013     2014     2015     2016     2017     2018     2019     2020
## 13.10635 13.08708 13.13854 13.11851 13.01871 13.03838 13.11825 13.00763
##     2021     2022
## 13.04708 12.92799
```

```
tapply(EV_data$EDUCpercBAplus , EV_data$yr, summary, na.rm = TRUE)
```

```
## $`2013`
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##    1.10   17.30   29.95   33.53   47.42   87.10
##
## $`2014`
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##    1.10   17.20   30.10   33.55   47.42   87.10
##
## $`2015`
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##    1.10   17.10   30.00   33.48   47.35   86.80
##
## $`2016`
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##    1.10   17.25   29.80   33.40   47.25   87.10
##
## $`2017`
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##    1.10   17.38   29.85   33.55   47.50   87.10
##
## $`2018`
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##    1.10   17.35   29.90   33.66   47.50   87.10
##
## $`2019`
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##    1.10   17.12   29.80   33.33   47.27   86.80
##
## $`2020`
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##    1.10   17.20   29.60   32.77   46.40   82.60
##
## $`2021`
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##    1.10   17.20   29.50   32.83   46.70   83.00
##
## $`2022`
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##    1.10   17.30   29.90   33.25   46.70   85.70
```

```
tapply(EV_data$EDUCpercBAplus , EV_data$yr, sd,      na.rm = TRUE)
```

```
##     2013     2014     2015     2016     2017     2018     2019     2020
## 19.89249 19.94024 19.96842 19.87392 19.94324 20.08068 19.86764 19.04289
##     2021     2022
## 19.13299 19.48771
```

```
#New dataset with just the variables of interest for Corr. Matrix

library(corrplot)
```

```
## corrplot 0.95 loaded
```

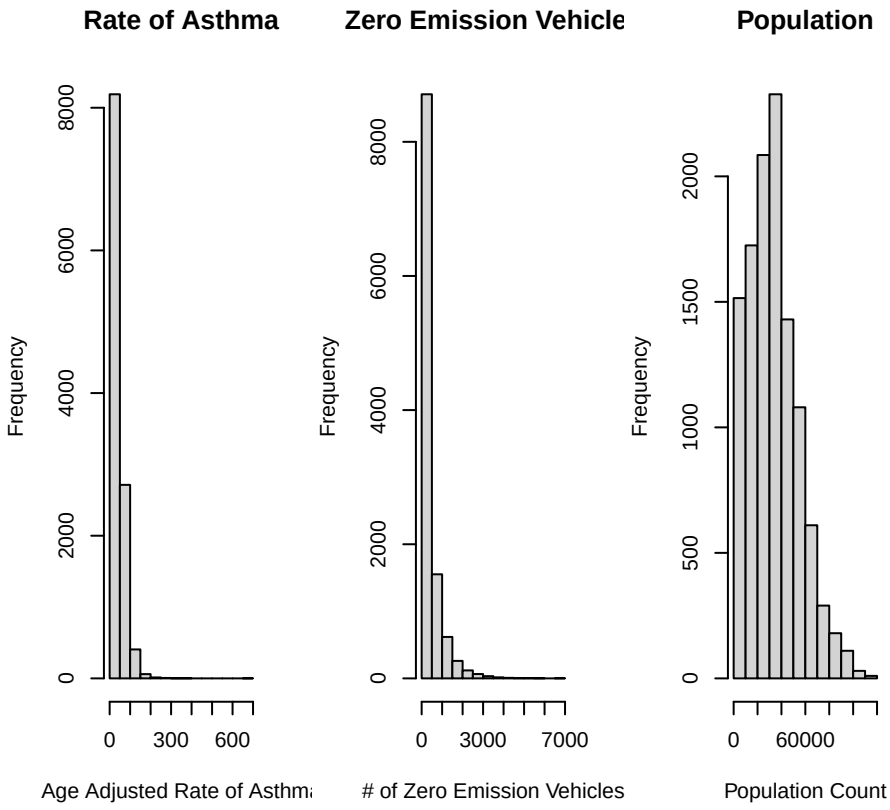
```
corr_EV_data_vars <- EV_data[, c(
  "nZEV",                       # number of electric vehicles
  "nZEV1000pop",               # EVs per 1000 people (you created this)
  "pop",                       # population
  "Age_Adjusted_Rate_of_Asthma_ED_Visit_Rate",  # asthma outcome
  "percPoverty",               # poverty %
  "HHincomeMedian",            # median income
  "HHincomeMean",              # mean income
  "EDUCpercHSplus",            # % with high school education or higher
  "EDUCpercBAplus"             # % with bachelor's degree or higher
)]

corr_EV_data_matrix <- cor(corr_EV_data_vars, use = "complete.obs")
print(corr_EV_data_matrix)
```

```
##                                              nZEV nZEV1000pop         pop
## nZEV                                    1.0000000  0.82739968  0.26510142
## nZEV1000pop                             0.8273997  1.00000000 -0.04152062
## pop                                     0.2651014 -0.04152062  1.00000000
## Age_Adjusted_Rate_of_Asthma_ED_Visit_Rate -0.3908522 -0.40111769 -0.04671280
## percPoverty                            -0.3481436 -0.37907673 -0.04634126
## HHincomeMedian                          0.4953929  0.57475848  0.01077475
## HHincomeMean                            0.4883625  0.60065490 -0.03456219
## EDUCpercHSplus                          0.3231912  0.39995856 -0.13220974
```

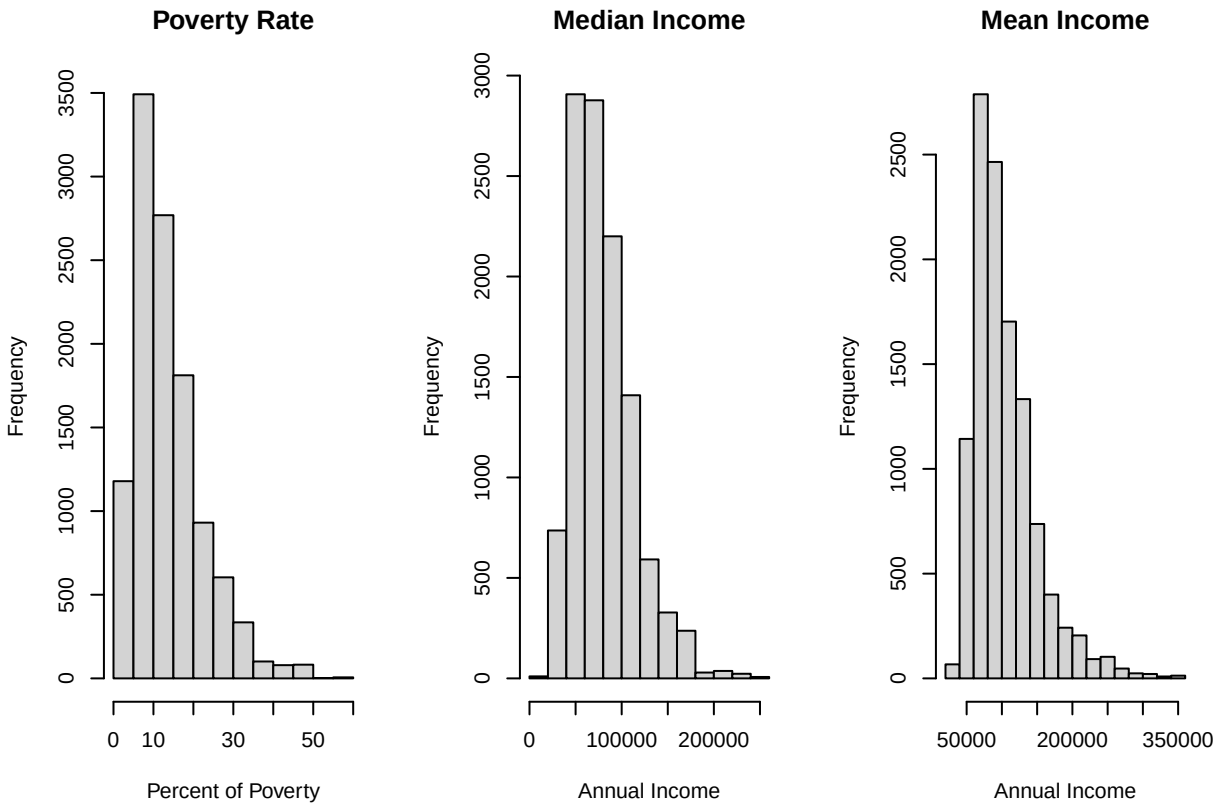
```
## EDUCpercBAplus                              0.4813832  0.58683326 -0.06569007
##                                          Age_Adjusted_Rate_of_Asthma_ED_Visit_Rate
## nZEV                                                                     -0.3908522
## nZEV1000pop                                                              -0.4011177
## pop                                                                      -0.0467128
## Age_Adjusted_Rate_of_Asthma_ED_Visit_Rate                                 1.0000000
## percPoverty                                                               0.5008629
## HHincomeMedian                                                           -0.4965716
## HHincomeMean                                                             -0.4891219
## EDUCpercHSplus                                                           -0.3656324
## EDUCpercBAplus                                                           -0.4740336
##                                          percPoverty HHincomeMedian
## nZEV                                      -0.34814358     0.49539288
## nZEV1000pop                               -0.37907673     0.57475848
## pop                                       -0.04634126     0.01077475
## Age_Adjusted_Rate_of_Asthma_ED_Visit_Rate  0.50086288    -0.49657156
## percPoverty                                1.00000000    -0.75584799
## HHincomeMedian                            -0.75584799     1.00000000
## HHincomeMean                              -0.68585072     0.96034650
## EDUCpercHSplus                            -0.67150251     0.63134316
## EDUCpercBAplus                            -0.56630830     0.79325673
##                                          HHincomeMean EDUCpercHSplus
## nZEV                                       0.48836247      0.3231912
## nZEV1000pop                                0.60065490      0.3999586
## pop                                       -0.03456219     -0.1322097
## Age_Adjusted_Rate_of_Asthma_ED_Visit_Rate  -0.48912191     -0.3656324
## percPoverty                               -0.68585072     -0.6715025
## HHincomeMedian                             0.96034650      0.6313432
## HHincomeMean                               1.00000000      0.6298838
## EDUCpercHSplus                             0.62988382      1.0000000
## EDUCpercBAplus                             0.84432010      0.7558573
##                                          EDUCpercBAplus
## nZEV                                         0.48138322
## nZEV1000pop                                  0.58683326
## pop                                         -0.06569007
## Age_Adjusted_Rate_of_Asthma_ED_Visit_Rate   -0.47403364
## percPoverty                                 -0.56630830
## HHincomeMedian                               0.79325673
## HHincomeMean                                 0.84432010
## EDUCpercHSplus                               0.75585726
## EDUCpercBAplus                               1.00000000
```

```r
##spaghetti plot
set.seed(99)
par(mfrow = c(1,3))
par(mfrow = c(1,4))
#Histograms of RoA, ZEVs, Population
hist(EV_data$Age_Adjusted_Rate_of_Asthma_ED_Visit_Rate, main = 'Rate of Asthma', xlab = 'Age Adjusted Ra
#hist(log_AgeAdj_RoA_ED_Visit_Rate, main = 'Log of Rate of Asthma', xlab = 'Age Adjusted Rate of Asthma
hist(EV_data$nZEV, main ='Zero Emission Vehicles', xlab = '# of Zero Emission Vehicles')
hist(EV_data$pop, main ='Population', xlab = 'Population Count')
```

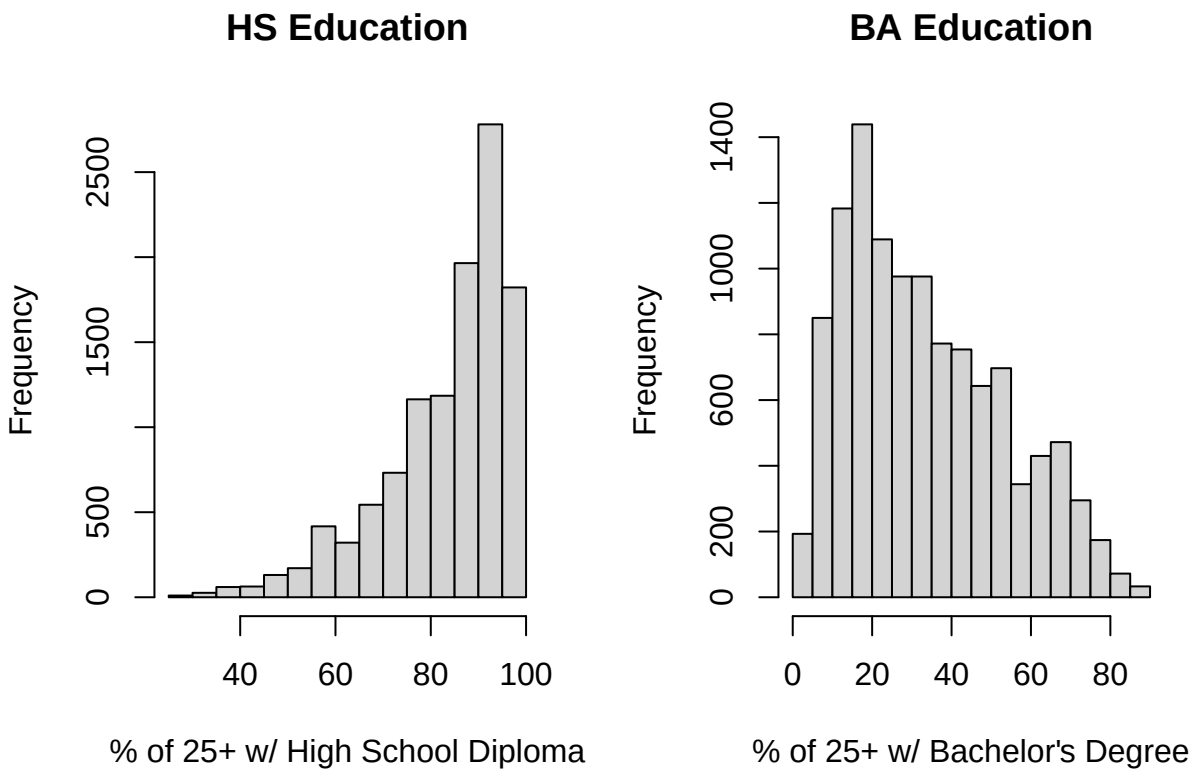



```r
#Histograms of Poverty rate, Median Income, Mean Income
par(mfrow = c(1,3))

hist(EV_data$percPoverty, main = 'Poverty Rate', xlab = 'Percent of Poverty')
hist(EV_data$HHincomeMedian, main ='Median Income', xlab = 'Annual Income')
hist(EV_data$HHincomeMean, main ='Mean Income', xlab = 'Annual Income')
```




```
par(mfrow = c(1,2))
#Histograms of HS Education, BA Education
hist(EV_data$EDUCpercHSplus, main = 'HS Education', xlab = '% of 25+ w/ High School Diploma')
hist(EV_data$EDUCpercBAplus, main ='BA Education', xlab = "% of 25+ w/ Bachelor's Degree")
```

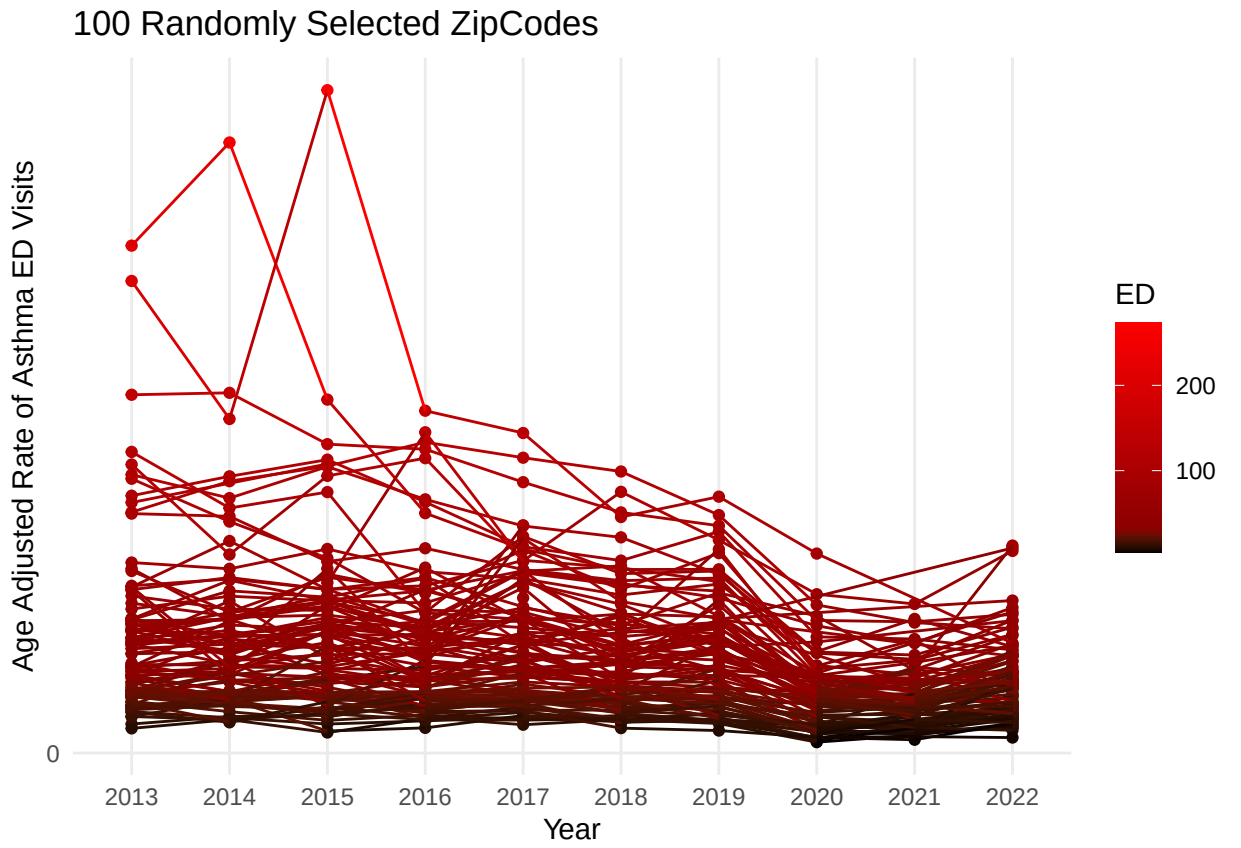



```
#EV spaghetti plot
EV_data$Age_Adjusted_Rate_of_Asthma_ED_Visit_Rate <- as.numeric(as.character(EV_data$Age_Adjusted_Rate_
library(scales)
zip = unique(EV_data$zip)
set.seed(100)
zip100 = sample(zip, 100)
EV_data_100 = EV_data[EV_data$zip %in% zip100,  ]
library(ggplot2)
EV_data_100 <- within(EV_data_100, {
  yr <- factor(yr)
  zip <- factor(zip)
  ED <- Age_Adjusted_Rate_of_Asthma_ED_Visit_Rate
})

p <- ggplot(data = EV_data_100, aes(x = yr, y = ED ,group = zip, color = ED)) +
geom_point(size = 1.5) +
  geom_line() +
  scale_color_gradientn(
    colors = c("black", "darkred", "red"),
    values = rescale(c(0, 500, 5000))) +
  theme_classic() +
  ggtitle("100 Randomly Selected ZipCodes") +
  xlab("Year") +
  ylab("Age Adjusted Rate of Asthma ED Visits") +

 scale_y_continuous(breaks = seq(0, 5000, by = 1200)) +
```

```
theme_minimal()
p
```




```
#nZEV spaghetti plot
EV_data$nZEV <- as.numeric(as.character(EV_data$nZEV))
EV_data_100$nZEV <- as.numeric(as.character(EV_data_100$nZEV))
zip <- unique(EV_data$zip)
set.seed(99)
zip100 <- sample(zip,100)
EV_data_100 = EV_data[EV_data$zip %in% zip100, ]

library(scales)
p <- ggplot(data = EV_data_100, aes(x = yr, y = nZEV, group = zip, color = nZEV)) +
  geom_point(size = 1.5) +
  geom_line() +
   scale_color_gradientn(
    colors = c("black", "darkred", "red"),
    values = rescale(c(0, 500, 5000))) +
  theme_classic() +

  ggtitle("100 Randomly Selected ZipCodes") +
  xlab("Year") +
  ylab("Number of Zero Emission Vehicles") +
  scale_y_continuous(breaks = seq(0, 5000, by = 1200))
theme_minimal()
```

```
## List of 136
##  $ line                            :List of 6
##   ..$ colour       : chr "black"
##   ..$ linewidth    : num 0.5
##   ..$ linetype     : num 1
##   ..$ lineend      : chr "butt"
##   ..$ arrow        : logi FALSE
##   ..$ inherit.blank: logi TRUE
##   ..- attr(*, "class")= chr [1:2] "element_line" "element"
##  $ rect                            :List of 5
##   ..$ fill         : chr "white"
##   ..$ colour       : chr "black"
##   ..$ linewidth    : num 0.5
##   ..$ linetype     : num 1
##   ..$ inherit.blank: logi TRUE
##   ..- attr(*, "class")= chr [1:2] "element_rect" "element"
##  $ text                            :List of 11
##   ..$ family       : chr ""
##   ..$ face         : chr "plain"
##   ..$ colour       : chr "black"
##   ..$ size         : num 11
##   ..$ hjust        : num 0.5
##   ..$ vjust        : num 0.5
##   ..$ angle        : num 0
##   ..$ lineheight   : num 0.9
##   ..$ margin       : 'margin' num [1:4] 0points 0points 0points 0points
##   .. ..- attr(*, "unit")= int 8
##   ..$ debug        : logi FALSE
##   ..$ inherit.blank: logi TRUE
##   ..- attr(*, "class")= chr [1:2] "element_text" "element"
##  $ title                           : NULL
##  $ aspect.ratio                    : NULL
##  $ axis.title                      : NULL
##  $ axis.title.x                    :List of 11
##   ..$ family       : NULL
##   ..$ face         : NULL
##   ..$ colour       : NULL
##   ..$ size         : NULL
##   ..$ hjust        : NULL
##   ..$ vjust        : num 1
##   ..$ angle        : NULL
##   ..$ lineheight   : NULL
##   ..$ margin       : 'margin' num [1:4] 2.75points 0points 0points 0points
##   .. ..- attr(*, "unit")= int 8
##   ..$ debug        : NULL
##   ..$ inherit.blank: logi TRUE
##   ..- attr(*, "class")= chr [1:2] "element_text" "element"
##  $ axis.title.x.top                :List of 11
##   ..$ family       : NULL
##   ..$ face         : NULL
##   ..$ colour       : NULL
##   ..$ size         : NULL
##   ..$ hjust        : NULL
##   ..$ vjust        : num 0
```

```
##   ..$ angle        : NULL
##   ..$ lineheight   : NULL
##   ..$ margin       : 'margin' num [1:4] 0points 0points 2.75points 0points
##   .. ..- attr(*, "unit")= int 8
##   ..$ debug        : NULL
##   ..$ inherit.blank: logi TRUE
##   ..- attr(*, "class")= chr [1:2] "element_text" "element"
##  $ axis.title.x.bottom             : NULL
##  $ axis.title.y                    :List of 11
##   ..$ family       : NULL
##   ..$ face         : NULL
##   ..$ colour       : NULL
##   ..$ size         : NULL
##   ..$ hjust        : NULL
##   ..$ vjust        : num 1
##   ..$ angle        : num 90
##   ..$ lineheight   : NULL
##   ..$ margin       : 'margin' num [1:4] 0points 2.75points 0points 0points
##   .. ..- attr(*, "unit")= int 8
##   ..$ debug        : NULL
##   ..$ inherit.blank: logi TRUE
##   ..- attr(*, "class")= chr [1:2] "element_text" "element"
##  $ axis.title.y.left               : NULL
##  $ axis.title.y.right              :List of 11
##   ..$ family       : NULL
##   ..$ face         : NULL
##   ..$ colour       : NULL
##   ..$ size         : NULL
##   ..$ hjust        : NULL
##   ..$ vjust        : num 1
##   ..$ angle        : num -90
##   ..$ lineheight   : NULL
##   ..$ margin       : 'margin' num [1:4] 0points 0points 0points 2.75points
##   .. ..- attr(*, "unit")= int 8
##   ..$ debug        : NULL
##   ..$ inherit.blank: logi TRUE
##   ..- attr(*, "class")= chr [1:2] "element_text" "element"
##  $ axis.text                       :List of 11
##   ..$ family       : NULL
##   ..$ face         : NULL
##   ..$ colour       : chr "grey30"
##   ..$ size         : 'rel' num 0.8
##   ..$ hjust        : NULL
##   ..$ vjust        : NULL
##   ..$ angle        : NULL
##   ..$ lineheight   : NULL
##   ..$ margin       : NULL
##   ..$ debug        : NULL
##   ..$ inherit.blank: logi TRUE
##   ..- attr(*, "class")= chr [1:2] "element_text" "element"
##  $ axis.text.x                     :List of 11
##   ..$ family       : NULL
##   ..$ face         : NULL
##   ..$ colour       : NULL
```

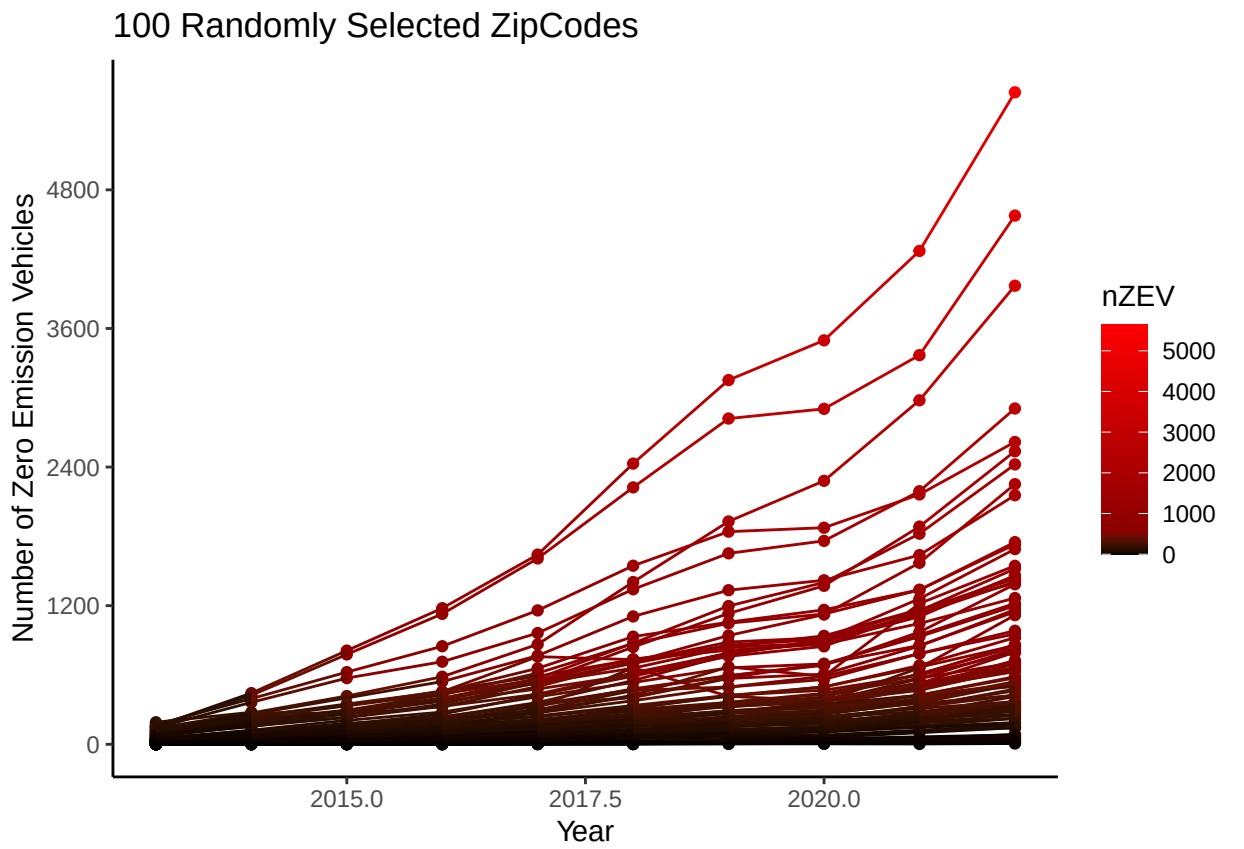
```
##   ..$ size         : NULL
##   ..$ hjust        : NULL
##   ..$ vjust        : num 1
##   ..$ angle        : NULL
##   ..$ lineheight   : NULL
##   ..$ margin       : 'margin' num [1:4] 2.2points 0points 0points 0points
##   .. ..- attr(*, "unit")= int 8
##   ..$ debug        : NULL
##   ..$ inherit.blank: logi TRUE
##   ..- attr(*, "class")= chr [1:2] "element_text" "element"
##  $ axis.text.x.top                :List of 11
##   ..$ family       : NULL
##   ..$ face         : NULL
##   ..$ colour       : NULL
##   ..$ size         : NULL
##   ..$ hjust        : NULL
##   ..$ vjust        : num 0
##   ..$ angle        : NULL
##   ..$ lineheight   : NULL
##   ..$ margin       : 'margin' num [1:4] 0points 0points 2.2points 0points
##   .. ..- attr(*, "unit")= int 8
##   ..$ debug        : NULL
##   ..$ inherit.blank: logi TRUE
##   ..- attr(*, "class")= chr [1:2] "element_text" "element"
##  $ axis.text.x.bottom             : NULL
##  $ axis.text.y                    :List of 11
##   ..$ family       : NULL
##   ..$ face         : NULL
##   ..$ colour       : NULL
##   ..$ size         : NULL
##   ..$ hjust        : num 1
##   ..$ vjust        : NULL
##   ..$ angle        : NULL
##   ..$ lineheight   : NULL
##   ..$ margin       : 'margin' num [1:4] 0points 2.2points 0points 0points
##   .. ..- attr(*, "unit")= int 8
##   ..$ debug        : NULL
##   ..$ inherit.blank: logi TRUE
##   ..- attr(*, "class")= chr [1:2] "element_text" "element"
##  $ axis.text.y.left               : NULL
##  $ axis.text.y.right              :List of 11
##   ..$ family       : NULL
##   ..$ face         : NULL
##   ..$ colour       : NULL
##   ..$ size         : NULL
##   ..$ hjust        : num 0
##   ..$ vjust        : NULL
##   ..$ angle        : NULL
##   ..$ lineheight   : NULL
##   ..$ margin       : 'margin' num [1:4] 0points 0points 0points 2.2points
##   .. ..- attr(*, "unit")= int 8
##   ..$ debug        : NULL
##   ..$ inherit.blank: logi TRUE
##   ..- attr(*, "class")= chr [1:2] "element_text" "element"
```

```
##  $ axis.text.theta                : NULL
##  $ axis.text.r                    :List of 11
##   ..$ family       : NULL
##   ..$ face         : NULL
##   ..$ colour       : NULL
##   ..$ size         : NULL
##   ..$ hjust        : num 0.5
##   ..$ vjust        : NULL
##   ..$ angle        : NULL
##   ..$ lineheight   : NULL
##   ..$ margin       : 'margin' num [1:4] 0points 2.2points 0points 2.2points
##   .. ..- attr(*, "unit")= int 8
##   ..$ debug        : NULL
##   ..$ inherit.blank: logi TRUE
##   ..- attr(*, "class")= chr [1:2] "element_text" "element"
##  $ axis.ticks                     : list()
##   ..- attr(*, "class")= chr [1:2] "element_blank" "element"
##  $ axis.ticks.x                   : NULL
##  $ axis.ticks.x.top               : NULL
##  $ axis.ticks.x.bottom            : NULL
##  $ axis.ticks.y                   : NULL
##  $ axis.ticks.y.left              : NULL
##  $ axis.ticks.y.right             : NULL
##  $ axis.ticks.theta               : NULL
##  $ axis.ticks.r                   : NULL
##  $ axis.minor.ticks.x.top         : NULL
##  $ axis.minor.ticks.x.bottom      : NULL
##  $ axis.minor.ticks.y.left        : NULL
##  $ axis.minor.ticks.y.right       : NULL
##  $ axis.minor.ticks.theta         : NULL
##  $ axis.minor.ticks.r             : NULL
##  $ axis.ticks.length              : 'simpleUnit' num 2.75points
##   ..- attr(*, "unit")= int 8
##  $ axis.ticks.length.x            : NULL
##  $ axis.ticks.length.x.top        : NULL
##  $ axis.ticks.length.x.bottom     : NULL
##  $ axis.ticks.length.y            : NULL
##  $ axis.ticks.length.y.left       : NULL
##  $ axis.ticks.length.y.right      : NULL
##  $ axis.ticks.length.theta        : NULL
##  $ axis.ticks.length.r            : NULL
##  $ axis.minor.ticks.length        : 'rel' num 0.75
##  $ axis.minor.ticks.length.x      : NULL
##  $ axis.minor.ticks.length.x.top  : NULL
##  $ axis.minor.ticks.length.x.bottom: NULL
##  $ axis.minor.ticks.length.y      : NULL
##  $ axis.minor.ticks.length.y.left : NULL
##  $ axis.minor.ticks.length.y.right : NULL
##  $ axis.minor.ticks.length.theta  : NULL
##  $ axis.minor.ticks.length.r      : NULL
##  $ axis.line                      : list()
##   ..- attr(*, "class")= chr [1:2] "element_blank" "element"
##  $ axis.line.x                    : NULL
##  $ axis.line.x.top                : NULL
```

```
##  $ axis.line.x.bottom             : NULL
##  $ axis.line.y                    : NULL
##  $ axis.line.y.left               : NULL
##  $ axis.line.y.right              : NULL
##  $ axis.line.theta                : NULL
##  $ axis.line.r                    : NULL
##  $ legend.background              : list()
##   ..- attr(*, "class")= chr [1:2] "element_blank" "element"
##  $ legend.margin                  : 'margin' num [1:4] 5.5points 5.5points 5.5points 5.5points
##   ..- attr(*, "unit")= int 8
##  $ legend.spacing                 : 'simpleUnit' num 11points
##   ..- attr(*, "unit")= int 8
##  $ legend.spacing.x               : NULL
##  $ legend.spacing.y               : NULL
##  $ legend.key                     : list()
##   ..- attr(*, "class")= chr [1:2] "element_blank" "element"
##  $ legend.key.size                : 'simpleUnit' num 1.2lines
##   ..- attr(*, "unit")= int 3
##  $ legend.key.height              : NULL
##  $ legend.key.width               : NULL
##  $ legend.key.spacing             : 'simpleUnit' num 5.5points
##   ..- attr(*, "unit")= int 8
##  $ legend.key.spacing.x           : NULL
##  $ legend.key.spacing.y           : NULL
##  $ legend.frame                   : NULL
##  $ legend.ticks                   : NULL
##  $ legend.ticks.length            : 'rel' num 0.2
##  $ legend.axis.line               : NULL
##  $ legend.text                    :List of 11
##   ..$ family       : NULL
##   ..$ face         : NULL
##   ..$ colour       : NULL
##   ..$ size         : 'rel' num 0.8
##   ..$ hjust        : NULL
##   ..$ vjust        : NULL
##   ..$ angle        : NULL
##   ..$ lineheight   : NULL
##   ..$ margin       : NULL
##   ..$ debug        : NULL
##   ..$ inherit.blank: logi TRUE
##   ..- attr(*, "class")= chr [1:2] "element_text" "element"
##  $ legend.text.position           : NULL
##  $ legend.title                   :List of 11
##   ..$ family       : NULL
##   ..$ face         : NULL
##   ..$ colour       : NULL
##   ..$ size         : NULL
##   ..$ hjust        : num 0
##   ..$ vjust        : NULL
##   ..$ angle        : NULL
##   ..$ lineheight   : NULL
##   ..$ margin       : NULL
##   ..$ debug        : NULL
##   ..$ inherit.blank: logi TRUE
```

```
##   ..- attr(*, "class")= chr [1:2] "element_text" "element"
##  $ legend.title.position           : NULL
##  $ legend.position                 : chr "right"
##  $ legend.position.inside          : NULL
##  $ legend.direction                : NULL
##  $ legend.byrow                    : NULL
##  $ legend.justification            : chr "center"
##  $ legend.justification.top        : NULL
##  $ legend.justification.bottom     : NULL
##  $ legend.justification.left       : NULL
##  $ legend.justification.right      : NULL
##  $ legend.justification.inside     : NULL
##  $ legend.location                 : NULL
##  $ legend.box                      : NULL
##  $ legend.box.just                 : NULL
##  $ legend.box.margin               : 'margin' num [1:4] 0cm 0cm 0cm 0cm
##   ..- attr(*, "unit")= int 1
##  $ legend.box.background           : list()
##   ..- attr(*, "class")= chr [1:2] "element_blank" "element"
##  $ legend.box.spacing              : 'simpleUnit' num 11points
##   ..- attr(*, "unit")= int 8
##   [list output truncated]
##  - attr(*, "class")= chr [1:2] "theme" "gg"
##  - attr(*, "complete")= logi TRUE
##  - attr(*, "validate")= logi TRUE
```

```
p
```




```
paste("Number of ZipCo:",length(unique(EV_data$zip)))
```

```
## [1] "Number of ZipCo: 1242"
```

```
paste("Mean of population:", mean(EV_data$pop))
```

```
## [1] "Mean of population: 33528.5594276685"
```

```
paste("Max of population:", max(EV_data$pop))
```

```
## [1] "Max of population: 111165"
```

```
paste("Min of population",min(EV_data$pop))
```

```
## [1] "Min of population 702"
```

```
paste("Mean of mean",mean(EV_data$EDUCpercHSplus))
```

```
## [1] "Mean of mean 83.4176264044944"
```

Characteristic	N = 1,164[1]
pop	33,023 (20,796)
HHincomeMedian	79,830 (34,408)
percPoverty	14 (9)
EDUCpercHSplus	84 (13)
EDUCpercBAplus	34 (20)

[1] Mean (SD)

```
sd(EV_data$EDUCpercHSplus)
```

```
## [1] 13.05922
```

```
mean(EV_data$EDUCpercBAplus)
```

```
## [1] 33.34688
```

```
sd(EV_data$EDUCpercBAplus)
```

```
## [1] 19.73358
```

```
median(EV_data$HHincomeMedian)
```

```
## [1] 73093
```

```
sd(EV_data$HHincomeMedian)
```

```
## [1] 33689.54
```

```
mean(EV_data$percPoverty)
```

```
## [1] 13.72109
```

```
sd(EV_data$percPoverty)
```

```
## [1] 8.490329
```

```
EV_data |> filter(yr == 2013) |> tbl_summary(include = c(pop,HHincomeMedian,percPoverty,EDUCpercHSplus,
                        statistic = list(all_continuous() ~ "{mean} ({sd})"))
```

```
EV_data |> filter(yr %in% c(2013,2018,2022)) |>
        mutate(yr = as.factor(yr)) |>
        tbl_summary(include = c(pop,HHincomeMedian,percPoverty,EDUCpercHSplus,EDUCpercBAplus),
                        statistic = list(all_continuous() ~ "{mean} ({sd})"),
                    by = yr )
```

Characteristic	**2013** N = 1,164[1]	**2018** N = 1,163[1]	**2022** N = 1,117[1]
pop	33,023 (20,796)	33,052 (20,782)	34,067 (20,547)
HHincomeMedian	79,830 (34,408)	79,986 (34,484)	79,370 (33,186)
percPoverty	14 (9)	14 (9)	14 (8)
EDUCpercHSplus	84 (13)	84 (13)	83 (13)
EDUCpercBAplus	34 (20)	34 (20)	33 (19)

[1]Mean (SD)