# CO emissions

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## $ fuel\_id : Factor w/ 2 levels "0","1": 2 2 2 2 2 2 2 2 2 2 ...  
## $ voc\_id : Factor w/ 9 levels "1","2","3","4",..: 7 7 7 7 7 7 7 7 7 7 ...  
## $ class\_id : Factor w/ 6 levels "2","3","4","5",..: 6 6 6 6 6 6 6 6 6 6 ...  
## $ drive\_id : Factor w/ 3 levels "0","1","2": 1 1 1 1 1 1 1 1 1 1 ...  
## $ trip\_count : int 4 1 5 3 7 3 3 4 3 3 ...  
## $ total\_average\_speed : num 9.38 7.45 8.28 9.41 6.36 ...  
## $ max\_speed : num 61.2 32.1 66.2 50 68.1 ...  
## $ driving\_average\_speed : num 21.9 12 27.8 16.3 24.6 ...  
## $ distance\_total : num 172.9 22.3 87.4 148.9 40.3 ...  
## $ acceleration\_events\_per\_mile : num 6.78 13.82 5.61 9.4 6.62 ...  
## $ deceleration\_events\_per\_mile : num 6.78 13.82 5.61 9.4 6.62 ...  
## $ total\_stops : int 317 69 111 365 53 185 248 212 222 188 ...  
## $ average\_stop\_duration : num 121.3 59.3 384.3 75.3 1173.7 ...  
## $ max\_elevation : num 1134 980 1069 960 1053 ...  
## $ min\_elevation : num 812 829 815 795 814 ...  
## $ max\_climbing\_rate : num 8.06 3.69 7.65 5.87 5.43 ...  
## $ average\_climbing\_rate : num 0.82 0.691 0.944 0.69 0.79 ...  
## $ max\_descending\_rate : num -3.14e-05 -1.95e-05 -2.50e-05 -9.59e-05 -4.17e-04 ...  
## $ average\_descending\_rate : num -0.821 -0.563 -1.039 -0.599 -0.82 ...  
## $ max\_road\_grade : num 0.181 0.13 0.187 0.112 0.134 ...  
## $ mean\_road\_grade : num 1.93e-04 -1.47e-03 4.06e-04 -7.37e-04 -7.39e-05 ...  
## $ maximum\_kinetic\_power\_density\_demand : num 18.3 8.11 16.83 14.37 17.6 ...  
## $ total\_kinetic\_power\_density\_demand : num 55900 4841 18194 47218 7780 ...  
## $ average\_kinetic\_power\_density\_demand : num 3.86 1.51 3.1 3 2.62 ...  
## $ maximum\_potential\_power\_density\_demand : num 24.1 11 22.9 17.6 16.2 ...  
## $ total\_potential\_power\_density\_demand : num 35276 6232 16921 31872 7110 ...  
## $ average\_potential\_power\_density\_demand : num 2.45 2.07 2.82 2.06 2.36 ...  
## $ total\_aerodynamic\_power\_density\_demand : num 20563015 705082 19443171 12368140 9663613 ...  
## $ aerodynamic\_speed : num 12.16 6.27 16.63 10.16 17.26 ...  
## $ kinetic\_intensity : num 1.655 5.828 0.643 2.36 0.571 ...  
## $ average\_aerodynamic\_power\_density\_demand: num 723 106 1716 376 1638 ...  
## $ maximum\_rolling\_power\_density\_demand : num 268 140 290 219 298 ...  
## $ total\_rolling\_power\_density\_demand : num 2728965 351831 1379374 2349934 636325 ...  
## $ average\_rolling\_power\_density\_demand : num 94.9 52.1 120.6 70.6 106.9 ...  
## $ characteristic\_acceleration : num 0.245 0.229 0.178 0.244 0.17 ...  
## $ characteristic\_deceleration : num -0.245 -0.231 -0.178 -0.244 -0.172 ...  
## $ maximum\_kinetic\_power\_density\_regen : num -31.5 -11.6 -26.6 -18.7 -21.5 ...  
## $ total\_kinetic\_power\_density\_regen : num -55900 -4841 -18194 -47218 -7780 ...  
## $ average\_kinetic\_power\_density\_regen : num -3.91 -1.36 -3.26 -2.69 -2.6 ...  
## $ maximum\_potential\_power\_density\_regen : num -29.5 -11.9 -25.8 -13.4 -18.8 ...  
## $ total\_potential\_power\_density\_regen : num -35291 -6287 -16894 -31895 -7216 ...  
## $ average\_potential\_power\_density\_regen : num -2.45 -1.68 -3.11 -1.79 -2.45 ...  
## $ NOX : num 1292 167 653 1112 301 ...  
## $ CO : num 297.2 38.3 150.2 256 69.3 ...  
## $ PM2.5 : num 30.61 3.95 15.47 26.35 7.14 ...  
## $ PM10 : num 33.2 4.28 16.78 28.59 7.74 ...  
## - attr(\*, ".internal.selfref")=<externalptr>

## Loading required package: Matrix

## Loaded glmnet 3.0-2

## Loading required package: nlme

## This is mgcv 1.8-31. For overview type 'help("mgcv-package")'.

##   
## Family: gaussian   
## Link function: identity   
##   
## Formula:  
## CO ~ drive\_id + fuel\_id + voc\_id + class\_id + total\_average\_speed +   
## max\_elevation + min\_elevation + max\_descending\_rate + maximum\_kinetic\_power\_density\_demand +   
## average\_kinetic\_power\_density\_demand + average\_potential\_power\_density\_demand +   
## total\_aerodynamic\_power\_density\_demand + total\_rolling\_power\_density\_demand +   
## s(average\_kinetic\_power\_density\_regen) + s(average\_aerodynamic\_power\_density\_demand) +   
## s(mean\_road\_grade) + s(deceleration\_events\_per\_mile) + s(acceleration\_events\_per\_mile) +   
## s(aerodynamic\_speed) + s(maximum\_potential\_power\_density\_regen) +   
## s(maximum\_kinetic\_power\_density\_regen) + s(characteristic\_deceleration) +   
## s(characteristic\_acceleration) + s(kinetic\_intensity) + s(maximum\_potential\_power\_density\_demand) +   
## s(max\_road\_grade) + s(average\_descending\_rate) + s(average\_climbing\_rate) +   
## s(max\_climbing\_rate) + s(average\_stop\_duration) + s(total\_stops) +   
## s(trip\_count) + s(total\_kinetic\_power\_density\_regen) + s(total\_potential\_power\_density\_regen) +   
## s(average\_potential\_power\_density\_regen) + s(average\_rolling\_power\_density\_demand) +   
## s(maximum\_rolling\_power\_density\_demand) + s(total\_potential\_power\_density\_demand) +   
## s(total\_kinetic\_power\_density\_demand) + s(max\_speed) + s(driving\_average\_speed)  
##   
## Parametric coefficients:  
## Estimate Std. Error t value Pr(>|t|)  
## (Intercept) -1.355e+00 3.277e-01 -4.135 3.65e-05  
## drive\_id1 -4.368e+01 1.650e+00 -26.474 < 2e-16  
## drive\_id2 1.354e+00 2.131e-01 6.352 2.44e-10  
## fuel\_id1 -3.510e+01 1.050e+00 -33.423 < 2e-16  
## voc\_id2 -5.393e-01 8.330e-02 -6.474 1.11e-10  
## voc\_id3 -1.031e+00 2.870e-01 -3.591 0.000335  
## voc\_id4 -1.741e+01 7.160e-01 -24.319 < 2e-16  
## voc\_id5 -6.221e+00 7.340e-01 -8.476 < 2e-16  
## voc\_id6 -1.007e+01 9.903e-01 -10.166 < 2e-16  
## voc\_id10 -1.938e+00 6.330e-01 -3.061 0.002228  
## voc\_id14 -6.785e-01 1.003e+00 -0.676 0.498846  
## voc\_id18 2.785e+00 3.535e-01 7.880 4.54e-15  
## class\_id3 5.189e+01 1.788e+00 29.012 < 2e-16  
## class\_id4 -1.087e+01 4.757e-01 -22.848 < 2e-16  
## class\_id5 -1.964e+01 1.363e+00 -14.408 < 2e-16  
## class\_id6 -7.728e+00 1.652e+00 -4.679 3.01e-06  
## class\_id7 -1.811e+01 2.032e+00 -8.913 < 2e-16  
## total\_average\_speed -1.924e+00 3.178e-01 -6.055 1.58e-09  
## max\_elevation 3.874e-02 7.008e-03 5.527 3.53e-08  
## min\_elevation -4.531e-02 7.060e-03 -6.418 1.60e-10  
## max\_descending\_rate 1.687e-03 2.611e-04 6.460 1.22e-10  
## maximum\_kinetic\_power\_density\_demand 1.411e+00 1.604e-01 8.793 < 2e-16  
## average\_kinetic\_power\_density\_demand 8.363e+00 1.277e+00 6.552 6.67e-11  
## average\_potential\_power\_density\_demand -7.420e+00 8.809e-01 -8.424 < 2e-16  
## total\_aerodynamic\_power\_density\_demand -3.888e-06 4.173e-07 -9.317 < 2e-16  
## total\_rolling\_power\_density\_demand 2.031e-04 9.340e-06 21.742 < 2e-16  
##   
## (Intercept) \*\*\*  
## drive\_id1 \*\*\*  
## drive\_id2 \*\*\*  
## fuel\_id1 \*\*\*  
## voc\_id2 \*\*\*  
## voc\_id3 \*\*\*  
## voc\_id4 \*\*\*  
## voc\_id5 \*\*\*  
## voc\_id6 \*\*\*  
## voc\_id10 \*\*   
## voc\_id14   
## voc\_id18 \*\*\*  
## class\_id3 \*\*\*  
## class\_id4 \*\*\*  
## class\_id5 \*\*\*  
## class\_id6 \*\*\*  
## class\_id7 \*\*\*  
## total\_average\_speed \*\*\*  
## max\_elevation \*\*\*  
## min\_elevation \*\*\*  
## max\_descending\_rate \*\*\*  
## maximum\_kinetic\_power\_density\_demand \*\*\*  
## average\_kinetic\_power\_density\_demand \*\*\*  
## average\_potential\_power\_density\_demand \*\*\*  
## total\_aerodynamic\_power\_density\_demand \*\*\*  
## total\_rolling\_power\_density\_demand \*\*\*  
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## Approximate significance of smooth terms:  
## edf Ref.df F p-value   
## s(average\_kinetic\_power\_density\_regen) 2.1600 2.822 16.446 4.78e-10 \*\*\*  
## s(average\_aerodynamic\_power\_density\_demand) 0.9464 1.310 26.020 2.61e-05 \*\*\*  
## s(mean\_road\_grade) 3.0247 3.838 1.462 0.17659   
## s(deceleration\_events\_per\_mile) 1.4135 1.841 45.045 < 2e-16 \*\*\*  
## s(acceleration\_events\_per\_mile) 1.4131 1.840 45.004 < 2e-16 \*\*\*  
## s(aerodynamic\_speed) 1.0827 1.494 50.552 3.14e-16 \*\*\*  
## s(maximum\_potential\_power\_density\_regen) 2.4474 3.065 1.654 0.19497   
## s(maximum\_kinetic\_power\_density\_regen) 2.4188 3.055 12.223 5.44e-08 \*\*\*  
## s(characteristic\_deceleration) 1.2525 1.647 13.230 1.06e-05 \*\*\*  
## s(characteristic\_acceleration) 1.3382 1.765 13.058 6.13e-06 \*\*\*  
## s(kinetic\_intensity) 1.4615 1.899 4.952 0.01865 \*   
## s(maximum\_potential\_power\_density\_demand) 2.1833 2.688 26.581 8.53e-09 \*\*\*  
## s(max\_road\_grade) 2.4987 3.212 10.586 3.28e-07 \*\*\*  
## s(average\_descending\_rate) 0.9549 1.248 7.951 0.00149 \*\*   
## s(average\_climbing\_rate) 1.0733 1.443 17.779 1.36e-06 \*\*\*  
## s(max\_climbing\_rate) 2.4063 3.119 2.210 0.05542 .   
## s(average\_stop\_duration) 2.6342 3.159 2.659 0.03082 \*   
## s(total\_stops) 1.5325 2.056 21.327 4.65e-10 \*\*\*  
## s(trip\_count) 1.9295 2.360 3.544 0.11207   
## s(total\_kinetic\_power\_density\_regen) 1.0360 1.373 26.043 1.12e-08 \*\*\*  
## s(total\_potential\_power\_density\_regen) 1.1727 1.545 0.581 0.43674   
## s(average\_potential\_power\_density\_regen) 1.0555 1.392 57.466 2.10e-12 \*\*\*  
## s(average\_rolling\_power\_density\_demand) 0.7442 1.015 33.510 5.59e-09 \*\*\*  
## s(maximum\_rolling\_power\_density\_demand) 1.3335 1.708 25.155 8.87e-10 \*\*\*  
## s(total\_potential\_power\_density\_demand) 1.2979 1.729 0.382 0.62236   
## s(total\_kinetic\_power\_density\_demand) 1.1898 1.622 17.577 4.74e-07 \*\*\*  
## s(max\_speed) 1.3397 1.721 24.828 9.49e-10 \*\*\*  
## s(driving\_average\_speed) 0.7493 1.021 32.185 8.12e-09 \*\*\*  
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## Rank: 169/278  
## R-sq.(adj) = 0.688 Deviance explained = 69.4%  
## GCV = 5634.6 Scale est. = 5537.4 n = 3078

