Stats 314, Data Analysis #5

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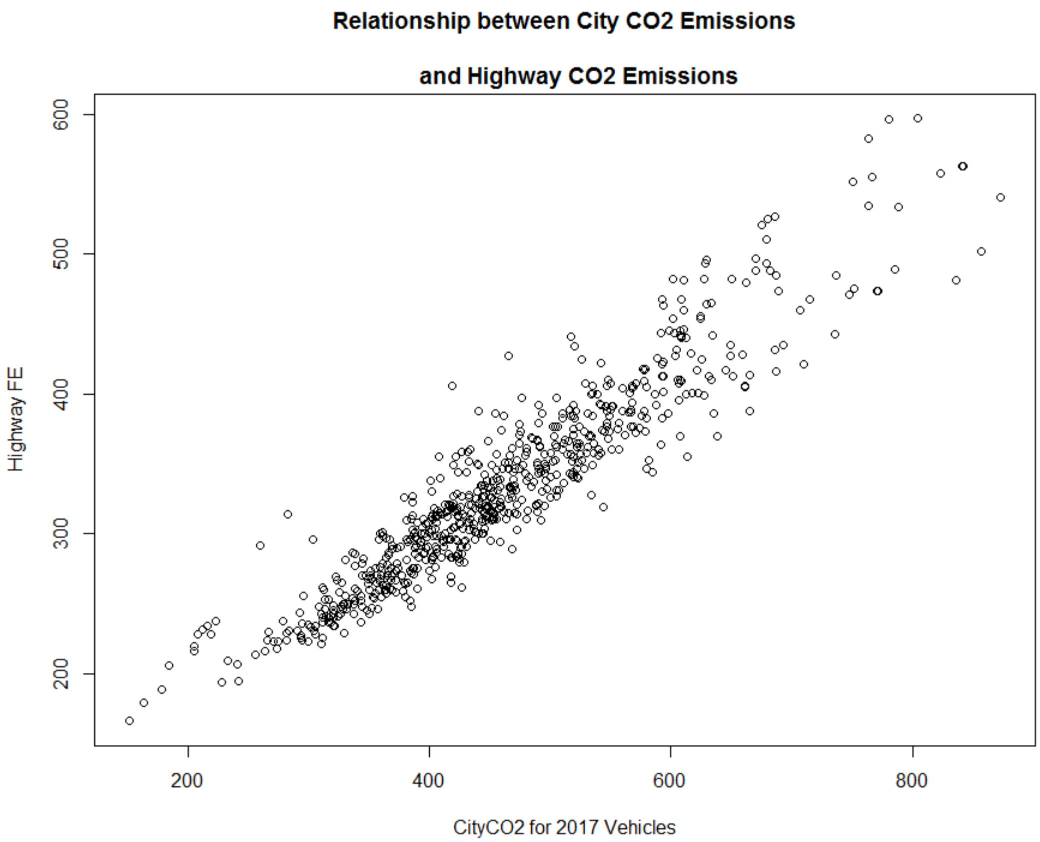
Part I

a



There seems to be a moderately strong, positive, linear relationship between City CO2 emmisions and Highway CO2 emmisions. There are a few positive outliers near the center of the scatterplot, and a balanced number of positive and negative outliers near the top right of the plot.

b

The correlation coefficient:
$r = .9418$
The coeffcient measures the linear association strength between two quantative variables. In this case, it is showing there is a fairly strong linear relationship between city CO2 emissions and highway CO2 emissions.

c

Residuals:
Min 1Q Median 3Q Max
-67.808 -14.695 -3.553 12.483 97.856

Coefficients:
Estimate Std. Error t value Pr(> $|t|$)
(Intercept) 66.325785 3.411020 19.45 $< 2e-16$ ***
CityCO2 0.577132 0.007082 81.50 $< 2e-16$ ***
—
Signif. codes: 0 *** 0.001 ** 0.01 * 0.05 . 0.1 1

Residual standard error: 23.79 on 846 degrees of freedom
Multiple R-squared: 0.887,Adjusted R-squared: 0.8869
F-statistic: 6642 on 1 and 846 DF, p-value: $< 2.2e-16$

Least squared regression line: $\hat{y} = b_0 + b_1 x$
$\hat{y} = 66.325 + .5771x$

d

i

$H_0 : B_1 = 0$
$H_a : B_1 \neq 0$

ii

$TestStatistic = \frac{.5771-0}{.007082}$
81.488

$p - value = .00000025$

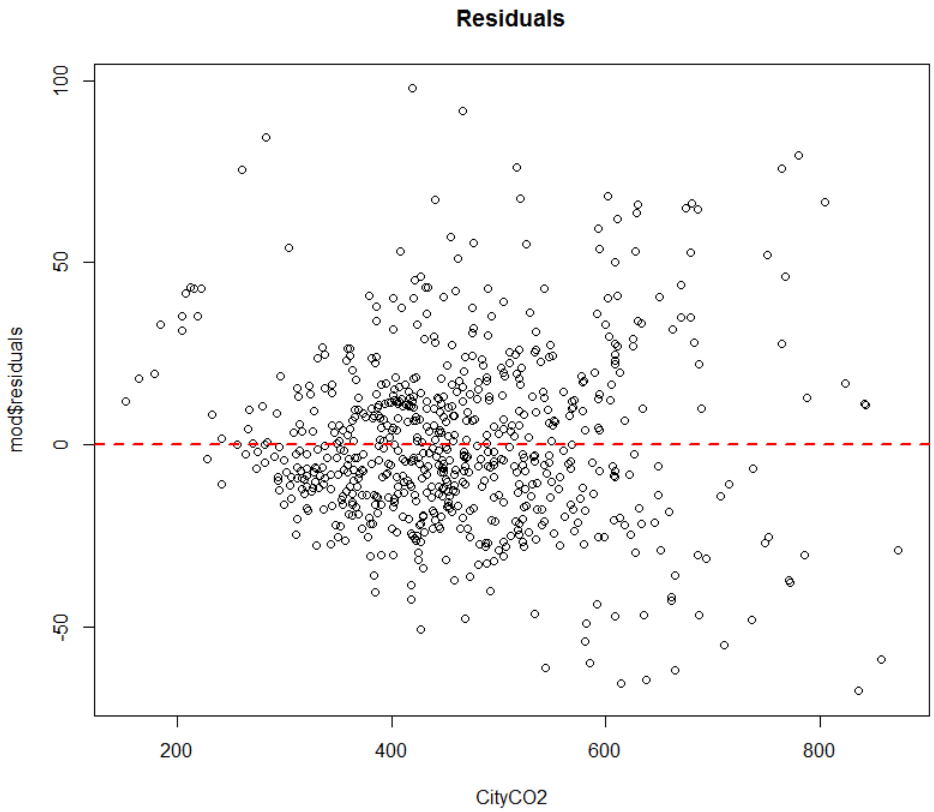
iii

The relationship between City CO2 emmisions and Highway CO2 looks to be convincingly strong, with a correlation of .94. As City CO2 increases, highway CO2 also increases. The relationship is modeled by the least squares regression equation:
$averageemissions = 66.325 + .5771x$
Average city CO2 emissions is a significant predictor for Highway CO2 emissions (t test stat = 81.5, df=846, and p-value .00000025).
The null hypothesis is rejected at a significant level of .01. The data supports the assumptions that increasing city emissions may increase highway CO2 emissions. The highway CO2 emissions are expected to increase .5771 for every 1 City CO2 emission increase.

e

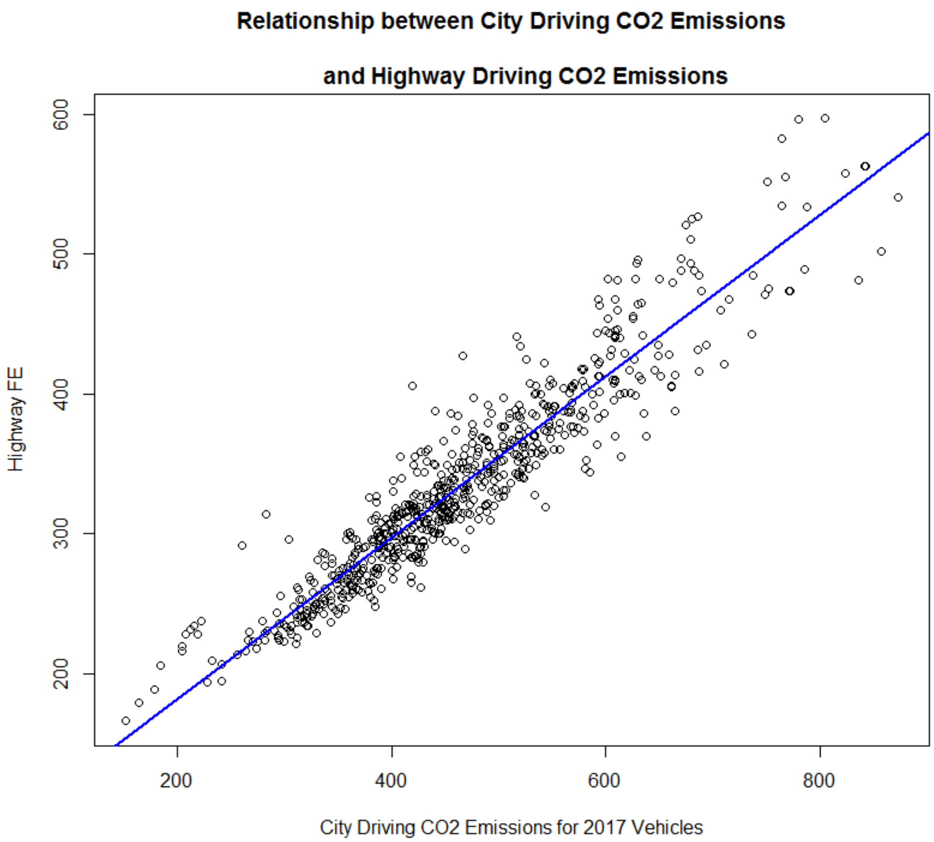
The slop shows how much the highway CO2 levels rise with the increase of city CO2 levels. With a 99% confidence interval from .5588 to .5954. That means with 99% confidence, we believe that the highway CO2 emissions increase by .5771 for each 1 increase in City CO2 emissions.

f



The conditions for a residual graph are:
No distinct patters: Met
Roughly Scattered around Zero: Met

g



Part II

a

Least squared regression line: $\hat{y} = 66.325 + .5771x$
Plug in our value: $\hat{y} = 66.325 + .5771 * 550 = 383.73$

b

Predicted: 383.73
Observed: 389
The difference between the observed and predicted is 5.27

c

The lower bound of our confidence interval is 381.1569
The upper bound of our confidence interval is 386.3398
The best fit for the interval is 383.7483

The upper and lower bounds are the 99% confidence interval range, with an estimated value of 383.7483.

d

The lower bound of the prediction interval is 322.2737
The upper bound of the prediction interval is 445.223
The best fit for the prediction interval is 383.7483
The upper and lower bounds are the 99% prediction interval range, with an estimated value of 383.7483.

e

The difference between a prediction interval and confidence interval is the standard error. The standard error in a prediction interval takes into account the variability due to random sampling.

Part III

a

Source	Degrees of Freedom	Sum of Squares	Mean Squares	F	p-val
Regression	3	0.2013	.0671	15.9052	$< .0001$
Residual	17	0.0675	.00421875		
Total	20	0.2688			

b

$R^2 = \frac{SSR}{SST} = \frac{.2013}{.2688} = .7488$
This value gives us the total proportion of our data that can be explained by the model. In this case, that's roughly 75%

c

i

$H_0 : B_1 = B_2 = B_3$
H_a : At least one B is significant

ii

$F = \frac{R^2/k}{(1-R^2)/(n-(k+1)} = \frac{MSR}{MSE} = \frac{.0671}{.00421875} = 15.905$
Numerator degrees of freedom:3
Denominator Degrees of Freedom:17
p-value:$> .0001$

iii

There is at least one significant factor

d

Least squares regression model $= -.6799 - .00293x_1 - .00157x_2 + .06471x_3$

e

1.008747 ppm