Carbon dioxide emissions and petroleum consumption

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# Author Note

# Abstract

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*Keywords:* t

# Introduction

Education is the best tool to change the behavior of the human population. The importance of this study is in allowing the data tell a good story, so that the general population can connect their decisions with the impact to the environment. The potential of this study and practical implications are that this information will change the automobile consumption and driving behaviors. Perhaps to persuade the public and the government to incentivize the public the use transportation and low emissions vehicles.

# Methodology

The data population is comprised of a variety of metrics on attributes that define an automobile. The table below describes the data, and what kind of data type it is. The table also highlights which data points are key or primary variables for our study.

|  |  |  |  |
| --- | --- | --- | --- |
| Data Types | Description | Included | Primary variable |
| Continuous | Barrels of fuel, for different types of fuel. | YES |  |
|  | Charge time, for electric vehicles. |  |  |
|  | Gasoline consumption. |  |  |
|  | Electric Vehicle (EV) Electricity consumption and utility factor |  |  |
| Continuous | Combined fuel consumption MPG, various fuel types. | YES | YES |
| Discrete | Tailpipe CO2 in grams/mile for different fuel types | YES | YES |
| Continuous | Engine Cylinders | YES |  |
| Discrete | Engine displacement | YES |  |
|  | Drive axel type |  |  |
|  | Engine Descriptor |  |  |
|  | Fuel cost |  |  |
|  | Subject to Guzzler tax |  |  |
|  | Highway fuel consumption for various circumstances. |  |  |
|  | Vehicle characteristics, such as make, model, transmission type, etcetera. |  |  |
| Discrete | Vehicle size (volume) | YES |  |
| Nominal | Vehicle categorization (Type) |  |  |
| Nominal | Emissions category |  |  |
| Nominal | Primary fuel type |  |  |
| Nominal | Make id |  |  |
| Nominal | Transmission type id |  |  |

The following table shows the Exploratory Data Analysis (EDA) for the data included in the work file.

|  |  |
| --- | --- |
| Description | Descriptive statistics |
| Annual consumption Barrels of fuel, for different types of fuel. | |  |  | | --- | --- | | *barrels08* |  | |  |  | | Mean | 17.1531662 | | Standard Error | 0.02244031 | | Median | 16.4805 | | Mode | 18.3116667 | | Standard Deviation | 4.66288822 | | Sample Variance | 21.7425265 | | Kurtosis | 2.11762875 | | Skewness | 0.36889414 | | Range | 47.0271429 | | Minimum | 0.06 | | Maximum | 47.0871429 | | Sum | 740622.258 | | Count | 43177 | |
| Combined MPG for various fuel types. | |  |  |  |  |  | | --- | --- | --- | --- | --- | |  | ***comb08*** | *combE* | *combinedCD* | *combinedUF* | |  |  |  |  |  | | Mean | **20.8459133** | 0.44523705 | 0.00025477 | 0.00164439 | | Standard Error | **0.039579** | 0.0218043 | 0.0001654 | 0.000195 | | Median | **20** | 0 | 0 | 0 | | Mode | **18** | 0 | 0 | 0 | | Standard Deviation | **8.22415022** | 4.53073206 | 0.03436782 | 0.04051824 | | Sample Variance | **67.6366468** | 20.527533 | 0.00118115 | 0.00164173 | | Kurtosis | **64.748981** | 147.721139 | 20764.2332 | 603.198396 | | Skewness | **6.35079311** | 11.4616397 | 143.19509 | 24.6002125 | | Range | **134** | 121 | 5 | 1 | | Minimum | **7** | 0 | 0 | 0 | | Maximum | **141** | 121 | 5 | 1 | | Sum | **900064** | 19224 | 11 | 71 | | Count | **43177** | 43177 | 43177 | 43177 | |
| Tailpipe CO2 in grams/mile for different fuel types | |  |  | | --- | --- | | *co2TailpipeGpm* |  | |  |  | | Mean | 462.766843 | | Standard Error | 0.60046952 | | Median | 444.35 | | Mode | 493.722222 | | Standard Deviation | 124.772017 | | Sample Variance | 15568.0563 | | Kurtosis | 2.07298355 | | Skewness | 0.41751327 | | Range | 1269.57143 | | Minimum | 0 | | Maximum | 1269.57143 | | Sum | 19980884 | | Count | 43177 | |
| Engine Cylinders | |  |  | | --- | --- | | *cylinders* |  | |  |  | | Mean | 5.71291097 | | Standard Error | 0.00851576 | | Median | 6 | | Mode | 4 | | Standard Deviation | 1.76416003 | | Sample Variance | 3.1122606 | | Kurtosis | 1.05923309 | | Skewness | 0.89820018 | | Range | 14 | | Minimum | 2 | | Maximum | 16 | | Sum | 245181 | | Count | 42917 | |
| Engine displacement | |  |  | | --- | --- | | *displ* |  | |  |  | | Mean | 3.28673781 | | Standard Error | 0.00655031 | | Median | 3 | | Mode | 2 | | Standard Deviation | 1.35702149 | | Sample Variance | 1.84150732 | | Kurtosis | -0.4918818 | | Skewness | 0.65812707 | | Range | 8.4 | | Minimum | 0 | | Maximum | 8.4 | | Sum | 141063.5 | | Count | 42919 | |

The following table takes the key variables from the list above and notes some observations made based on the characteristics of the sample data for the key variables.

|  |  |
| --- | --- |
| Key variable | Notes on descriptive statistics |
| Comb08 | uniformly distributed  skewed right  a few extreme outliers, with a small impact on the skewness.  A considerable amount of the data is with in +1 and -1 standard deviation  unimodal |
| combE, combinedCD, combinedUF | Not relevant for this study, unless we want to make the point that fuel consumed in powering electric vehicles reduce the overall emissions. |
|  |  |
| Co2TailpipeGPM |  |
|  | * unevenly distributed * skewed left * few outliers with a high impact on the skewness * multi modal * a considerable amount of the data is outside ±1 from standard deviation |

# Methodology

## Sample

Vehicle data has been obtained from FuelEconomy.gov Web Services (2020).

The sample included.

# References

**Table 1**

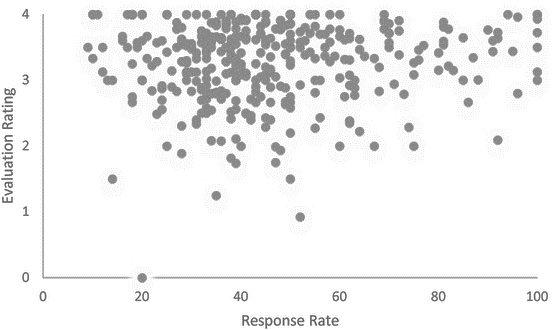
*Means and Standard Deviations for Response Rates (Course Delivery Method by Evaluation Year)*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Administration year | Face-to-face course | | Online course | |
| *M* | *SD* | *M* | *SD* |
| Year 1: 2012 | 71.72 | 16.42 | 32.93 | 15.73 |
| Year 2: 2013 | 72.31 | 14.93 | 32.55 | 15.96 |
| Year 3: 2014 | 47.18 | 20.11 | 41.60 | 18.23 |

*Note.* Student evaluations of teaching (SETs) were administered in two modalities in Years 1 and 2: paper based for face-to-face courses and online for online courses. SETs were administered online for all courses in Year 3.

**Figure 1**

*Scatterplot Depicting the Correlation Between Response Rates and Evaluation Ratings*



*Note.* Evaluation ratings were made during the 2014 fall academic term.