CO1 emissions

A Statistical Analysis of Vehicle Emissions Data

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Introduction

This research focuses on understanding the relationship between engine displacement and idle carbon monoxide (CO) emissions in vehicles. Carbon monoxide is a significant pollutant, and its emission levels are critical in evaluating environmental and public health impacts. By exploring the correlation between engine displacement and CO emissions, this study aims to identify patterns and provide insights that could inform regulatory measures and technological improvements in the automotive industry.

Methods

Data Collection

The dataset used in this analysis was obtained from a larger study on vehicle emissions, specifically focusing on idle CO emissions and various vehicle attributes, including engine displacement. The data was pre-processed to remove any rows with missing or zero values for the CO1 variable to ensure the accuracy and reliability of the results.

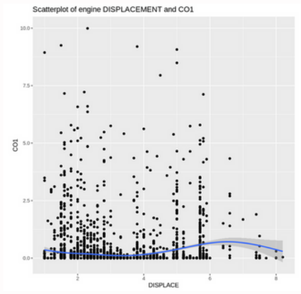
Statistical Analysis

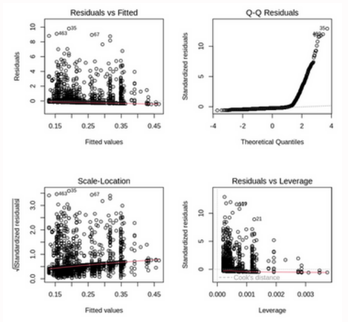
1. Exploratory Data Analysis (EDA): Initial data exploration was conducted to understand the distribution and relationships between the variables.
2. Scatter plots and summary statistics were used to visualize the data.
3. Linear Regression Model: A linear regression model was fitted
4. Assumption Checking: Diagnostic plots were generated to check the assumptions of the linear regression model, including linearity, normality of residuals, homoscedasticity, and absence of multicollinearity.

Results

- The scatterplot shows that vehicles with larger engine displacements potentially have higher idle mono-oxide (CO1) emissions.
- The linear model results show that there is a statistical significant correlation between engine displacements and CO1 emissions with a p-value of 5.81e-08.
- The coefficient for DISPLACE is 0.046265 indicating that for each unit increase in engine displacement, CO1 emissions increase by approximately 0.046 units, so it shows that vehicles with larger engine displacements have higher idle mono-oxide (CO1) emissions.
- The adjusted R-squared value of 0.005673 suggests that engine displacement explains a small proportion of the variance in CO1 emissions, indicating that other factors may also play significant roles.
- The confidence intervals for the DISPLACE coefficient (0.02957022 to 0.06296057) do not include zero, further supporting the significance of the relationship.
- From the other four graphs, we can also confirm that our result are generally valid, but there are some outliers in our dataset that need attention.

	Estimate	Standard error	T-value	P-value
Intercept	0,085128	0,026964	3,157	0,0016
Displace	0,046265	0,008516	5,433	5,81E-08





Discussion

- The results of this analysis provide valuable insights for policymakers and automotive manufacturers. By understanding the impact of engine displacement on CO emissions, more effective regulations and technological innovations can be developed to reduce the environmental footprint of vehicles. Future research could expand this study by including additional variables such as fuel type, vehicle age, and maintenance status to build a more comprehensive model of vehicle emissions.
- Additionally, while the linear regression model provided significant findings, further studies could explore non-linear models or machine learning approaches to capture more complex relationships between vehicle attributes and emissions. This would enhance the predictive power and applicability of the research in real-world scenarios.

Conclusion

This study demonstrates a clear positive correlation between engine displacement and idle CO emissions. Vehicles with larger engine displacements tend to emit higher levels of carbon monoxide when idling. These findings underscore the importance of considering engine size in emissions regulations and vehicle design to mitigate environmental pollution.

References: [1] Cobb, N., & Etzel, R. A. (1991). Unintentional carbon monoxide—Related deaths in the United States, 1979 through 1988. Jama, 266(5), 659-663.