Car Price Prediction

Problem Description

A Chinese automobile company aspires to enter the US market by setting up their manufacturing unit there and producing cars locally to give competition to their US and European counterparts. They have contracted an automobile consulting company to understand the factors on which the pricing of cars depends. Specifically, they want to understand the factors affecting the pricing of cars in the American market, since those may be very different from the Chinese market. Essentially, the company wants to know:

Which variables are significant in predicting the price of a car. How well those variables describe the price of a car. Based on various market surveys, the consulting firm has gathered a large dataset of different types of cars across the American market.

Business Goal

You are required to model the price of cars with the available independent variables. It will be used by the management to understand how exactly the prices vary with the independent variables. They can accordingly manipulate the design of the cars, the business strategy etc. to meet certain price levels. Further, the model will be a good way for the management to understand the pricing dynamics of a new market.

In [119…

```
 # import libraries
import numpy as np
import pandas as pd
import seaborn as sns
import matplotlib.pyplot as plt
from sklearn import preprocessing
```

In [120…

```
# import dataset
df = pd.read_csv("CarPrice_Dataset.csv")
```

1. Explore the data

In [121…

```
df
```

Out[121]:

	car_ID	symboling	CarName	fueltype	aspiration	doornumber	carbody	dri
0	1	3	alfa-romero giulia	gas	std	two	convertible	
1	2	3	alfa-romero stelvio	gas	std	two	convertible	
2	3	1	alfa-romero Quadrifoglio	gas	std	two	hatchback	
3	4	2	audi 100 ls	gas	std	four	sedan	
4	5	2	audi 100ls	gas	std	four	sedan	
...	...	...	...	...	...	...	...	
200	201	-1	volvo 145e (sw)	gas	std	four	sedan	
201	202	-1	volvo 144ea	gas	turbo	four	sedan	
202	203	-1	volvo 244dl	gas	std	four	sedan	
203	204	-1	volvo 246	diesel	turbo	four	sedan	
204	205	-1	volvo 264gl	gas	turbo	four	sedan	

205 rows × 26 columns

In [122…

```
df.shape
```

Out[122]:

```
(205, 26)
```

In [123…

```
df.columns
```

Out[123]:

```
Index(['car_ID', 'symboling', 'CarName', 'fueltype', 'aspiration',
       'doornumber', 'carbody', 'drivewheel', 'enginelocation', 'wheelbase',
       'carlength', 'carwidth', 'carheight', 'curbweight', 'enginetype',
       'cylindernumber', 'enginesize', 'fuelsystem', 'boreratio', 'stroke',
       'compressionratio', 'horsepower', 'peakrpm', 'citympg', 'highwaympg',
       'price'],
      dtype='object')
```

In [124…

```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 205 entries, 0 to 204
Data columns (total 26 columns):
 #   Column            Non-Null Count  Dtype  
---  ------            --------------  -----  
 0   car_ID            205 non-null    int64  
 1   symboling         205 non-null    int64  
 2   CarName           205 non-null    object 
 3   fueltype          205 non-null    object 
 4   aspiration        205 non-null    object 
 5   doornumber        205 non-null    object 
 6   carbody           205 non-null    object 
 7   drivewheel        205 non-null    object 
 8   enginelocation    205 non-null    object 
 9   wheelbase         205 non-null    float64
 10  carlength         205 non-null    float64
 11  carwidth          205 non-null    float64
 12  carheight         205 non-null    float64
 13  curbweight        205 non-null    int64  
 14  enginetype        205 non-null    object 
 15  cylindernumber    205 non-null    object 
 16  enginesize        205 non-null    int64  
 17  fuelsystem        205 non-null    object 
 18  boreratio         205 non-null    float64
 19  stroke            205 non-null    float64
 20  compressionratio  205 non-null    float64
 21  horsepower        205 non-null    int64  
 22  peakrpm           205 non-null    int64  
 23  citympg           205 non-null    int64  
 24  highwaympg        205 non-null    int64  
 25  price             205 non-null    float64
dtypes: float64(8), int64(8), object(10)
memory usage: 41.8+ KB
```

In [125…

```
df.isna().sum()
```

Out[125]:
```
car_ID              0
symboling           0
CarName             0
fueltype            0
aspiration          0
doornumber          0
carbody             0
drivewheel          0
enginelocation      0
wheelbase           0
carlength           0
carwidth            0
carheight           0
curbweight          0
enginetype          0
cylindernumber      0
enginesize          0
fuelsystem          0
boreratio           0
stroke              0
compressionratio    0
horsepower          0
peakrpm             0
citympg             0
highwaympg          0
price               0
dtype: int64
```

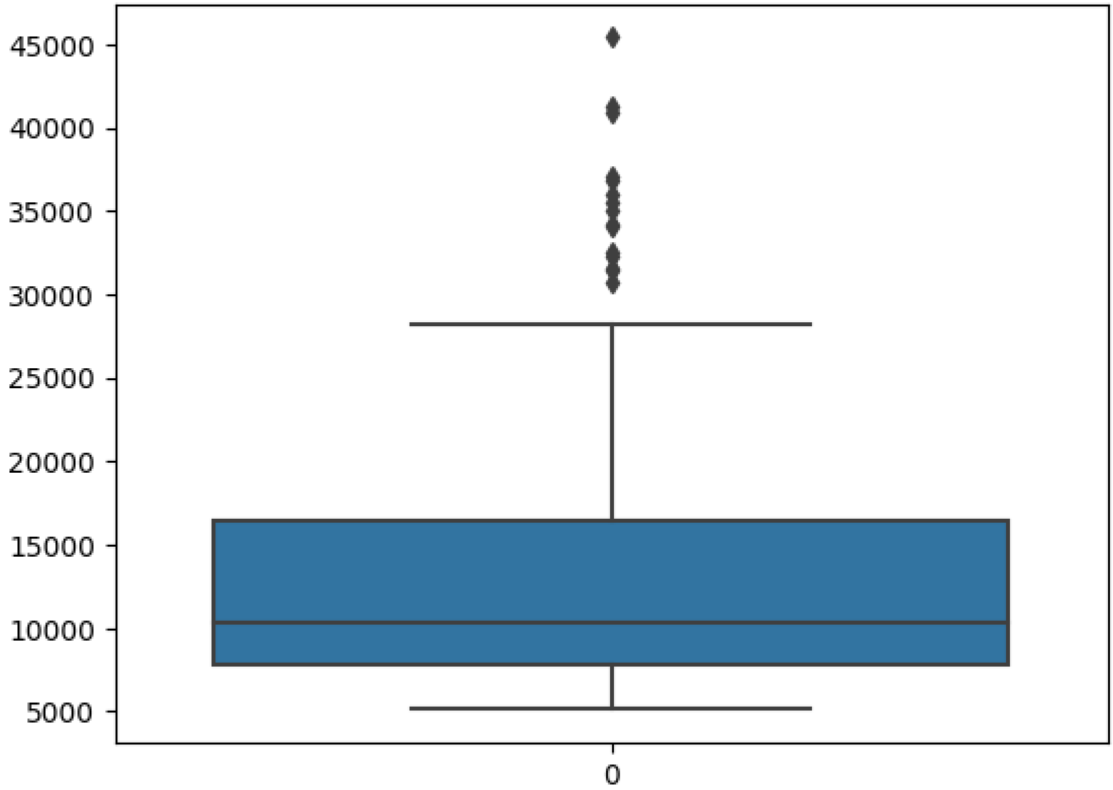
In [126…
```
df.duplicated().sum()
```

Out[126]:
```
0
```

2. Data Preprocessing

In [127…
```
#check for outliers
sns.boxplot(data=df['price'])
```

Out[127]:
```
<Axes: >
```



In [128…

```
# ouliers are there for price , but not removing it.
```

In [129…

```
#Encode the categorical datas from the dataset using Label Encoder. For ML Model
```

In [130…

```
categorical_cols = df.select_dtypes(include=['object']).columns
categorical_cols
```

Out[130]:

```
Index(['CarName', 'fueltype', 'aspiration', 'doornumber', 'carbody',
       'drivewheel', 'enginelocation', 'enginetype', 'cylindernumber',
       'fuelsystem'],
      dtype='object')
```

In [131…

```
label=preprocessing.LabelEncoder()
df.fueltype=label.fit_transform(df.fueltype)
df.aspiration = label.fit_transform(df.aspiration)
df.doornumber = label.fit_transform(df.doornumber)
df.carbody = label.fit_transform(df.carbody)
df.drivewheel = label.fit_transform(df.drivewheel)
df.enginelocation = label.fit_transform(df.enginelocation)
df.enginetype = label.fit_transform(df.enginetype)
df.cylindernumber = label.fit_transform(df.cylindernumber)
df.fuelsystem = label.fit_transform(df.fuelsystem)
```

In [132…

```
df
```

Out[132]:

	car_ID	symboling	CarName	fueltype	aspiration	doornumber	carbody	drive
0	1	3	alfa-romero giulia	1	0	1	0	
1	2	3	alfa-romero stelvio	1	0	1	0	
2	3	1	alfa-romero Quadrifoglio	1	0	1	2	
3	4	2	audi 100 ls	1	0	0	3	
4	5	2	audi 100ls	1	0	0	3	
...	...	...	...	...	...	...	...	
200	201	-1	volvo 145e (sw)	1	0	0	3	
201	202	-1	volvo 144ea	1	1	0	3	
202	203	-1	volvo 244dl	1	0	0	3	
203	204	-1	volvo 246	0	1	0	3	
204	205	-1	volvo 264gl	1	1	0	3	

205 rows × 26 columns

In [133…

```
# Scaling the numerical columns
numerical_cols=df.select_dtypes(include=['int64','float64']).columns
numerical_cols
```

Out[133]:

```
Index(['car_ID', 'symboling', 'wheelbase', 'carlength', 'carwidth',
       'carheight', 'curbweight', 'enginesize', 'boreratio', 'stroke',
       'compressionratio', 'horsepower', 'peakrpm', 'citympg', 'highwaympg',
       'price'],
      dtype='object')
```

In [134…

```
scaler = StandardScaler()
df[numerical_cols] = scaler.fit_transform(df[numerical_cols])
```

In [135…

```
# Creating scatter plots for columns against 'price'
df.drop(columns=['car_ID','CarName'],axis=1,inplace=True)
for col in df:
    sns.scatterplot(data=df, x=col, y='price')
    plt.show()
```

```
C:\Users\hp\AppData\Local\Programs\Python\Python311\Lib\site-packages\seaborn\_ol
dcore.py:1498: FutureWarning: is_categorical_dtype is deprecated and will be remo
ved in a future version. Use isinstance(dtype, CategoricalDtype) instead
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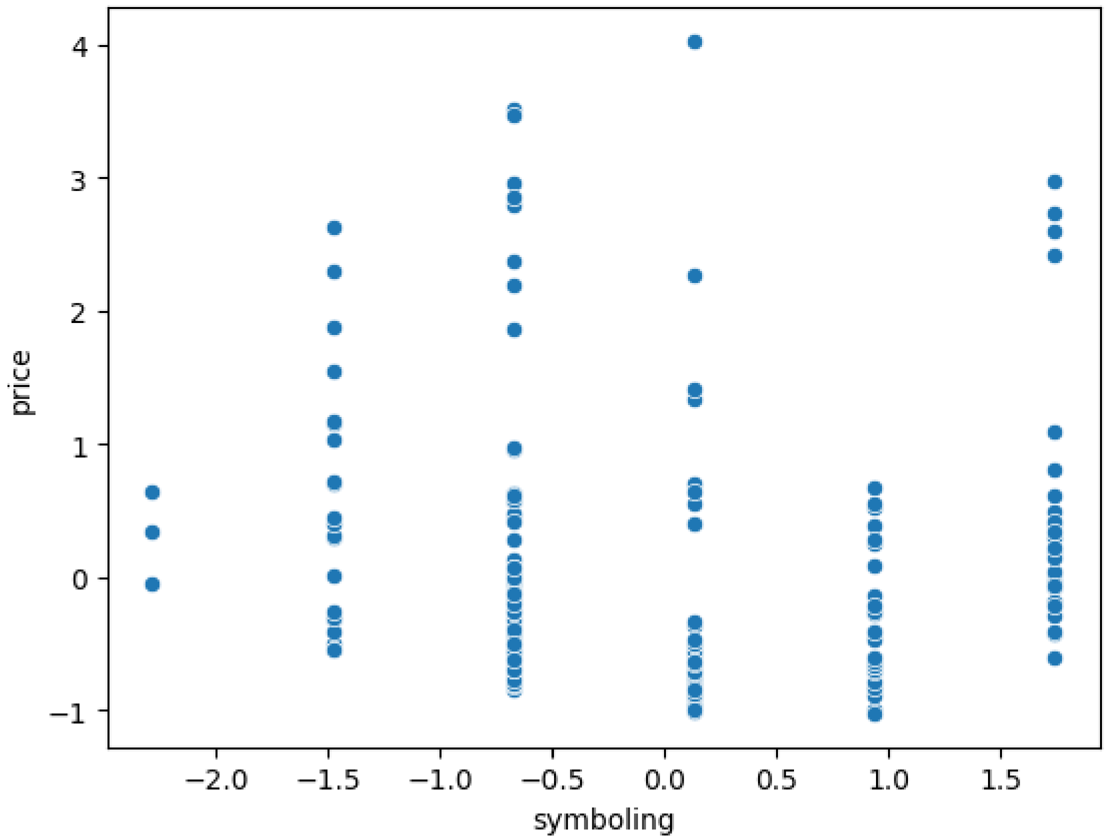


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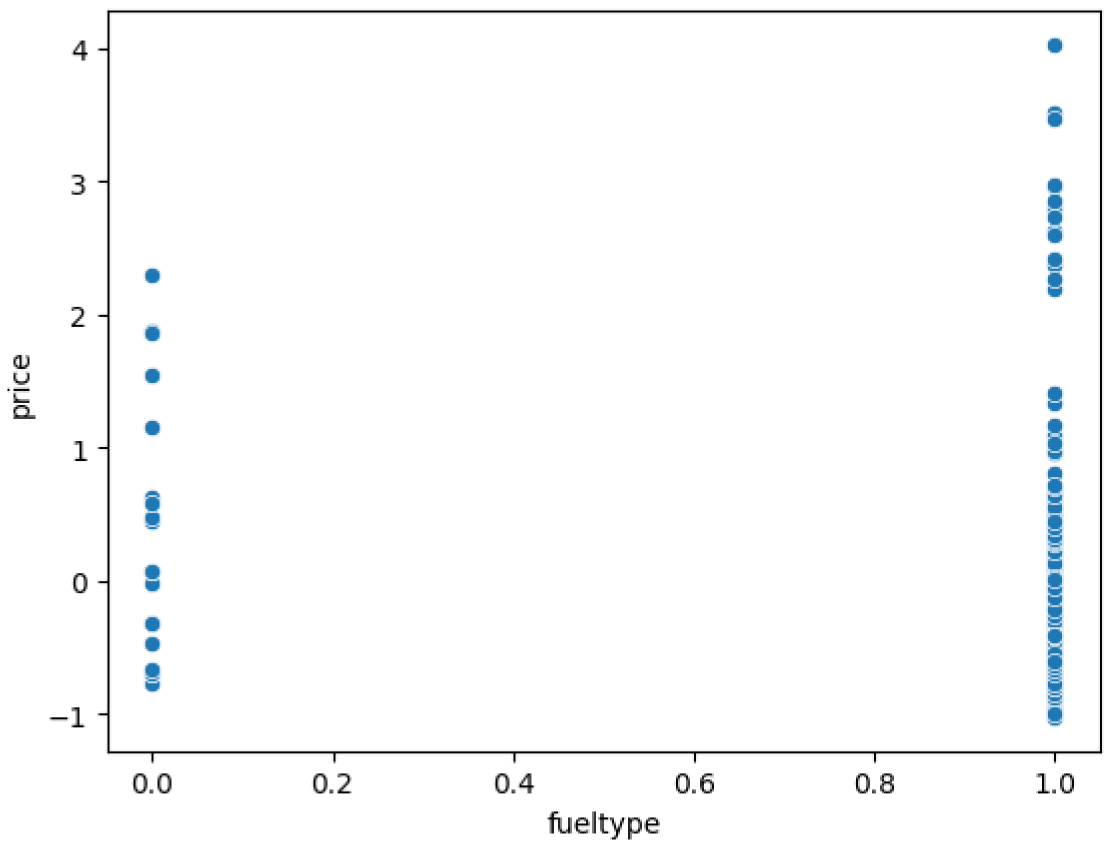

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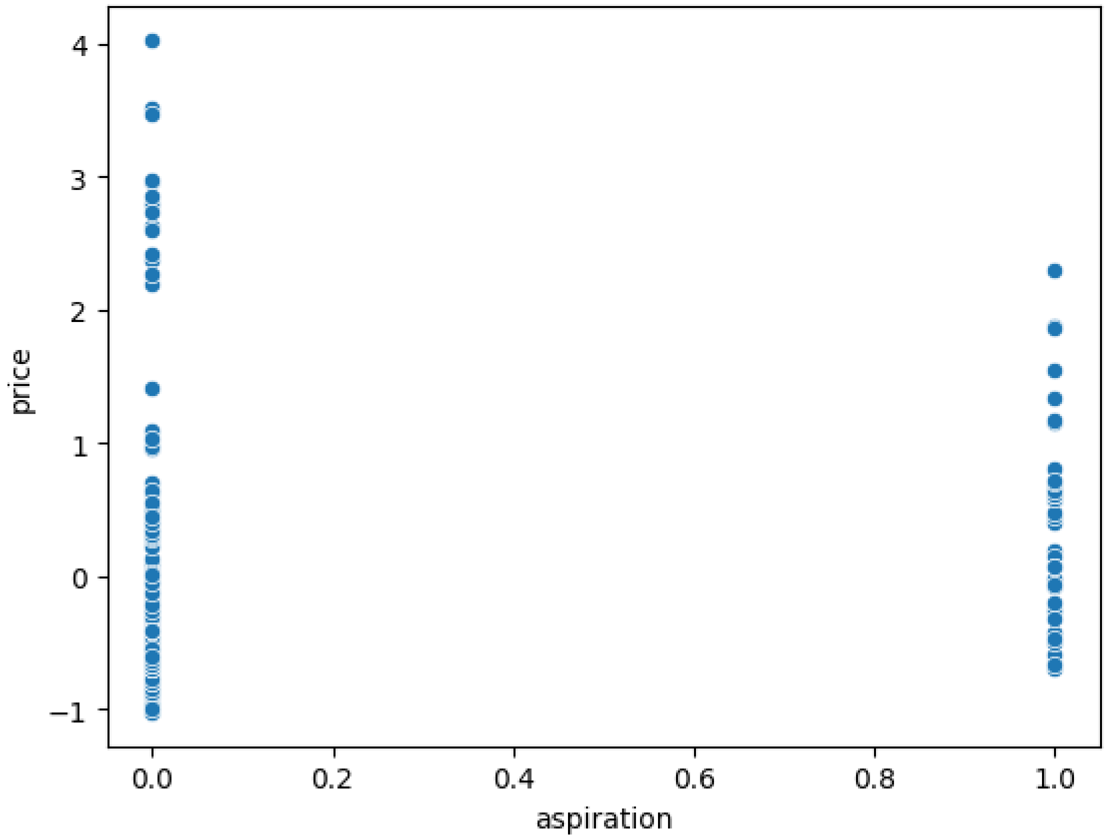


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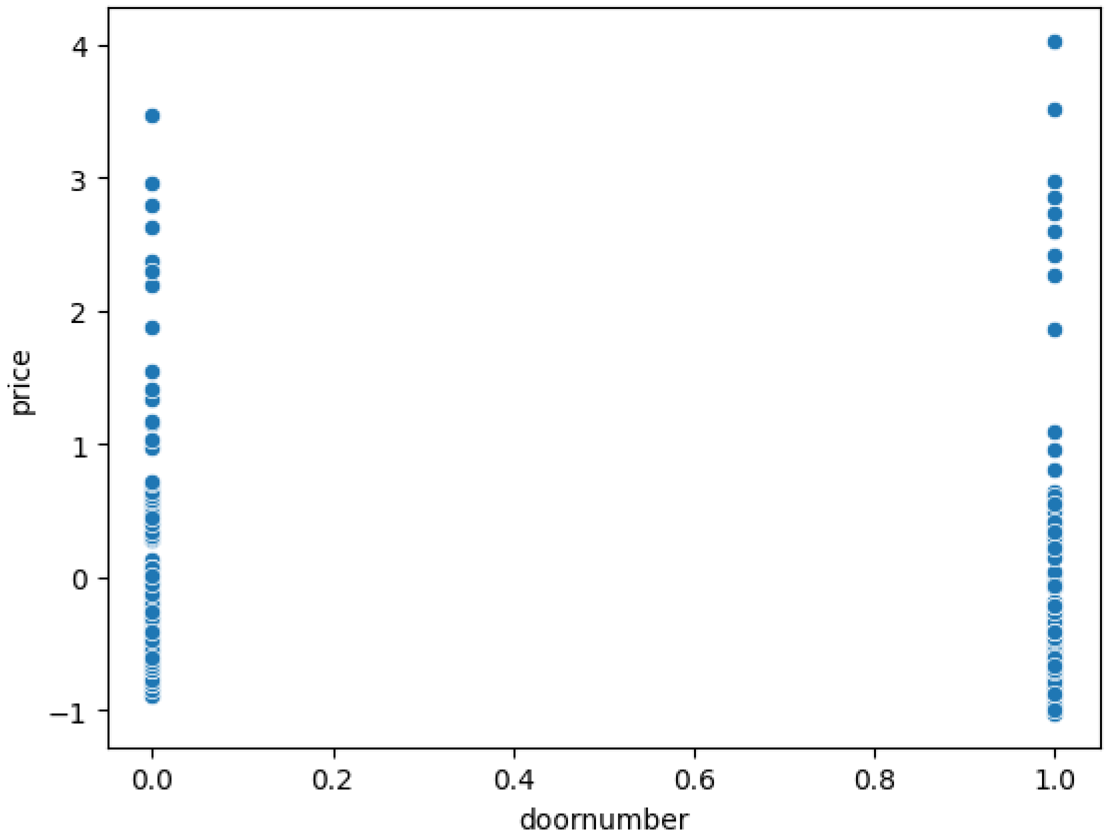


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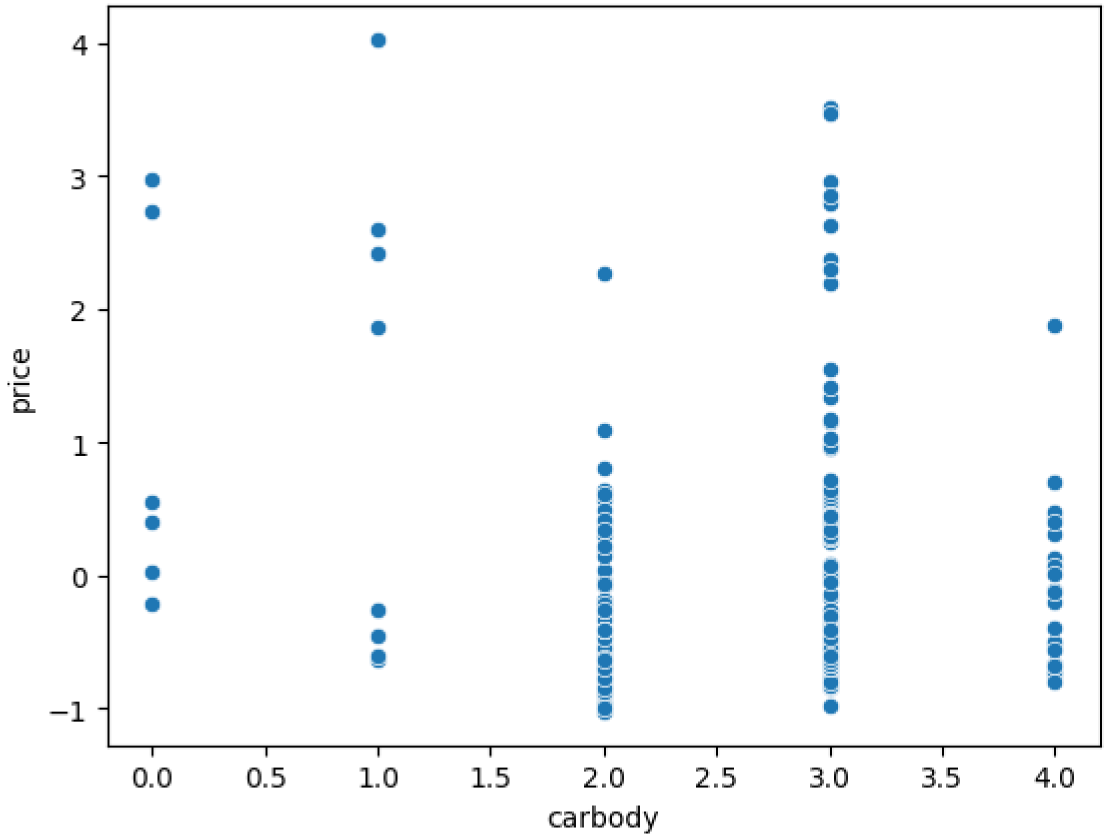

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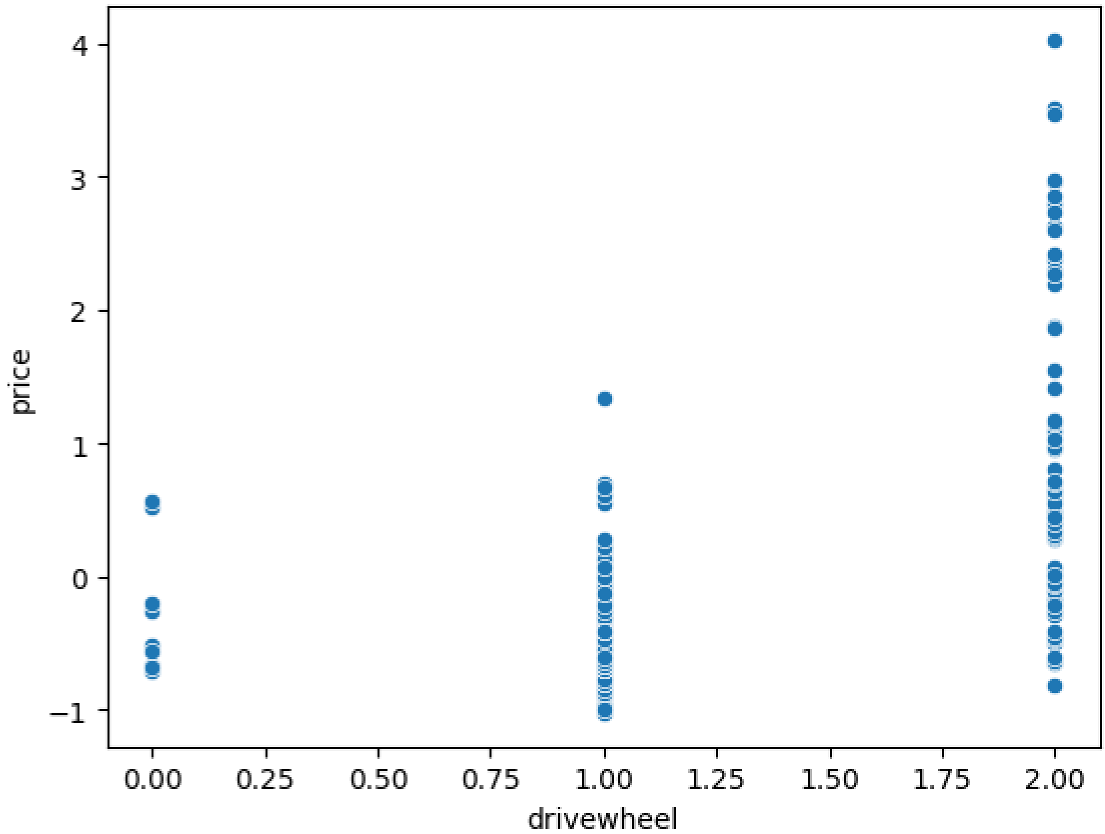


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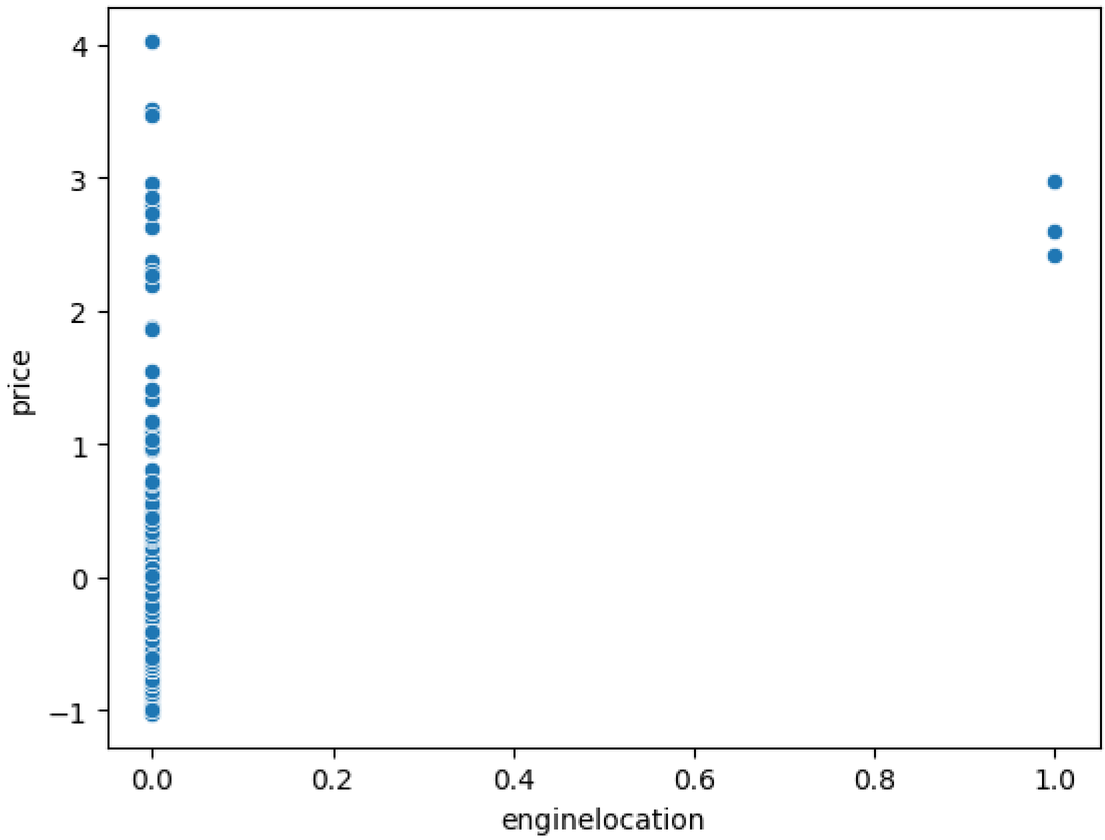


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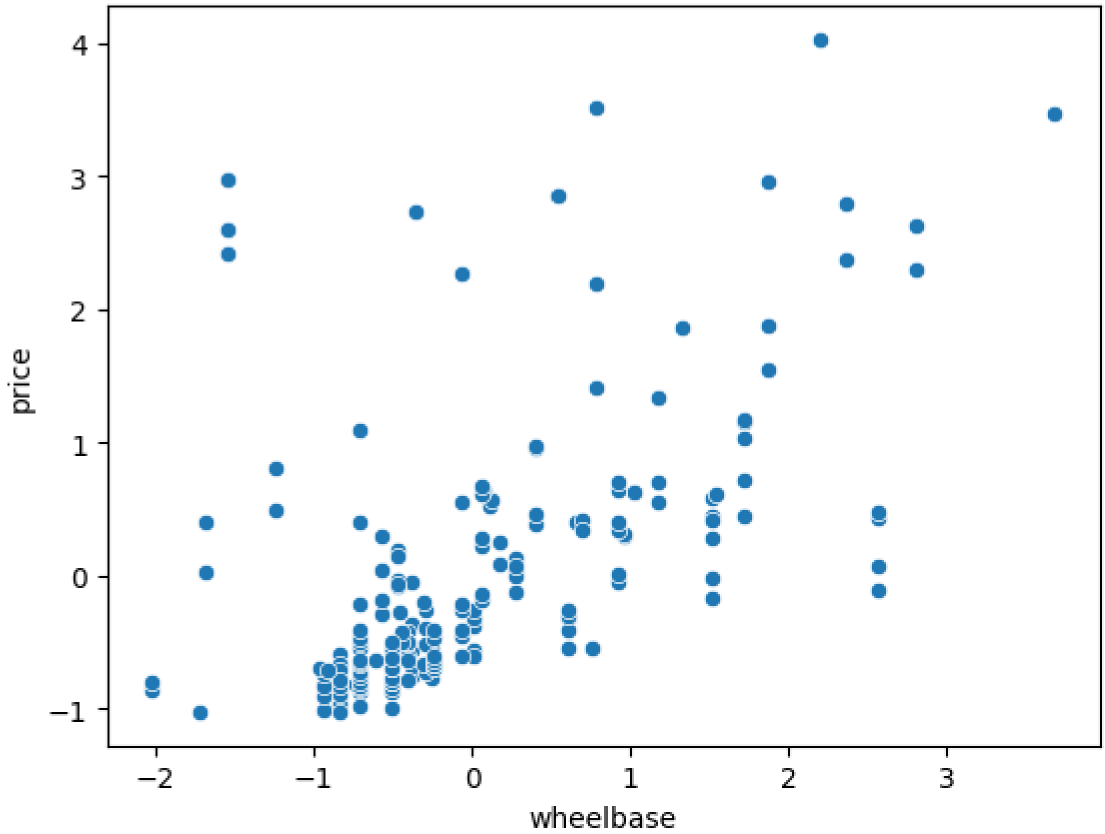

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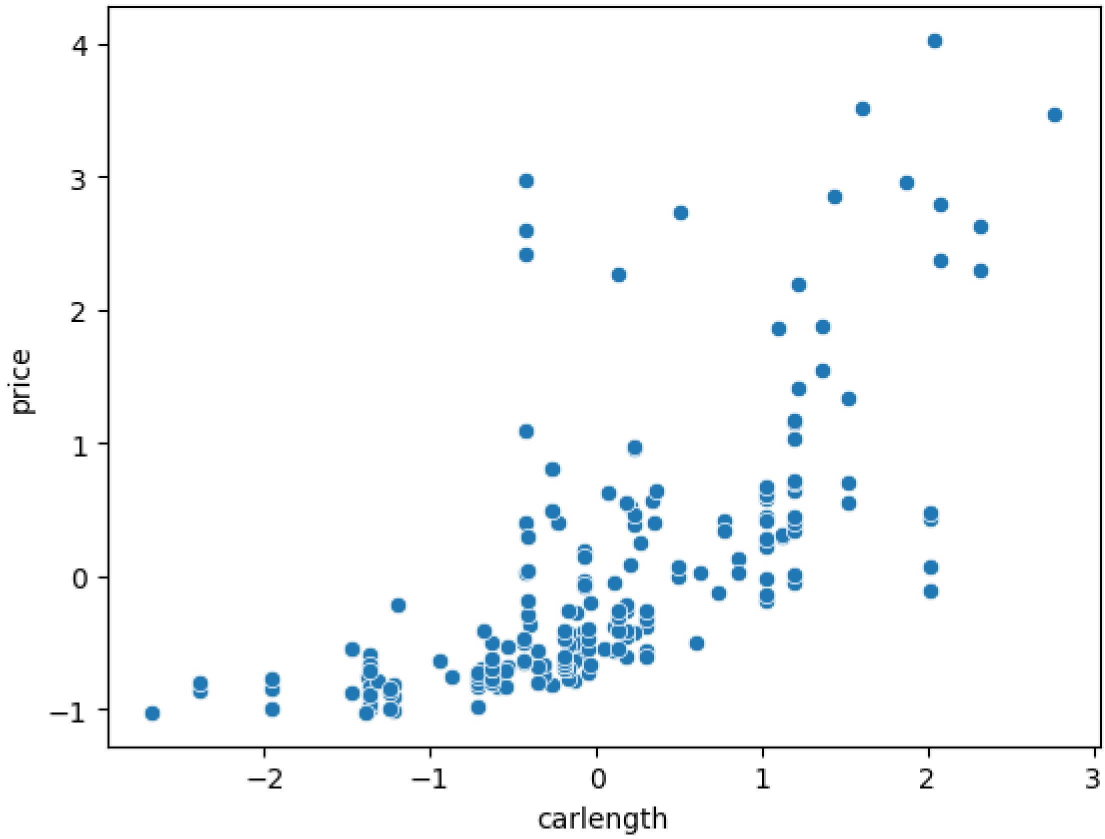


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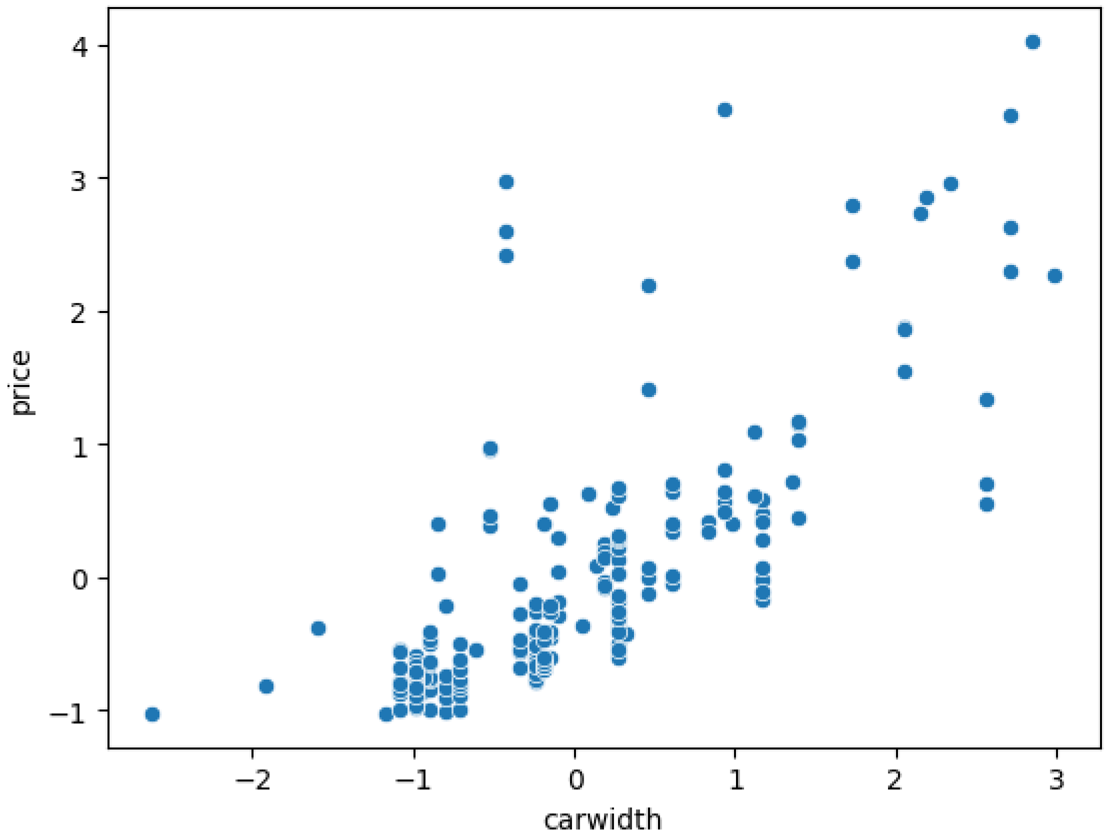


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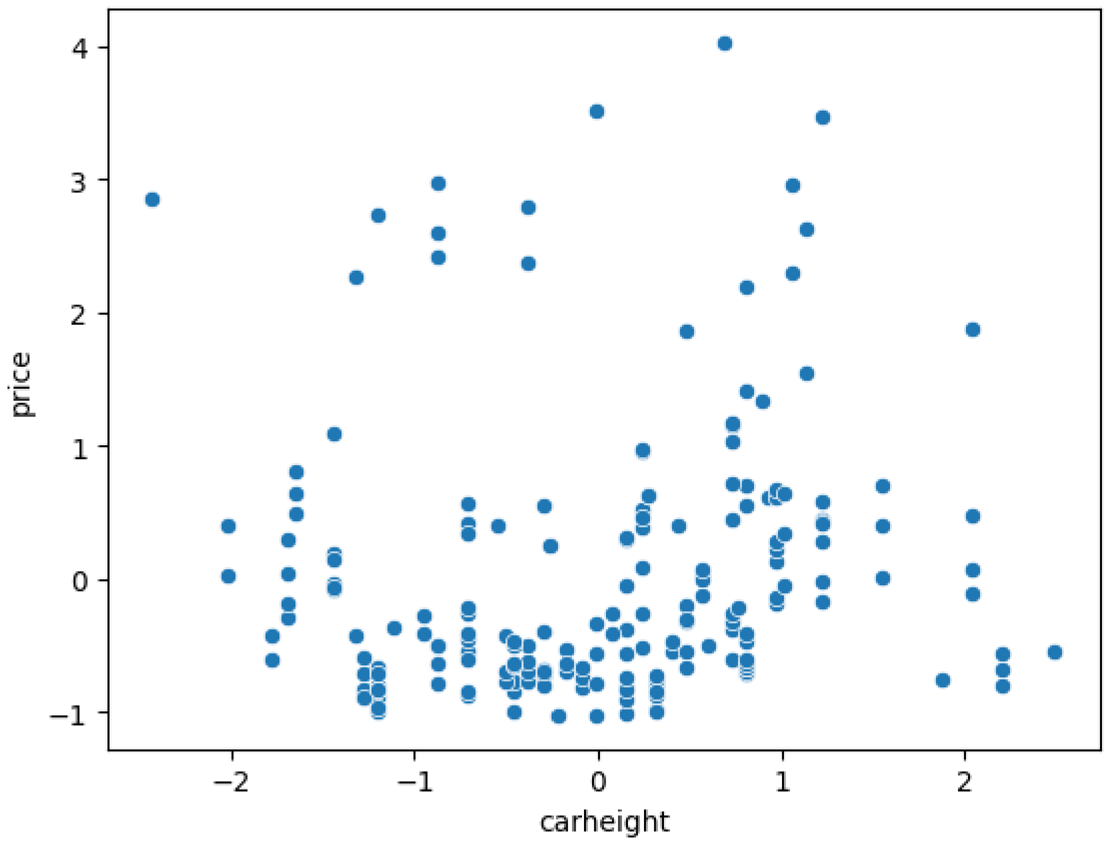

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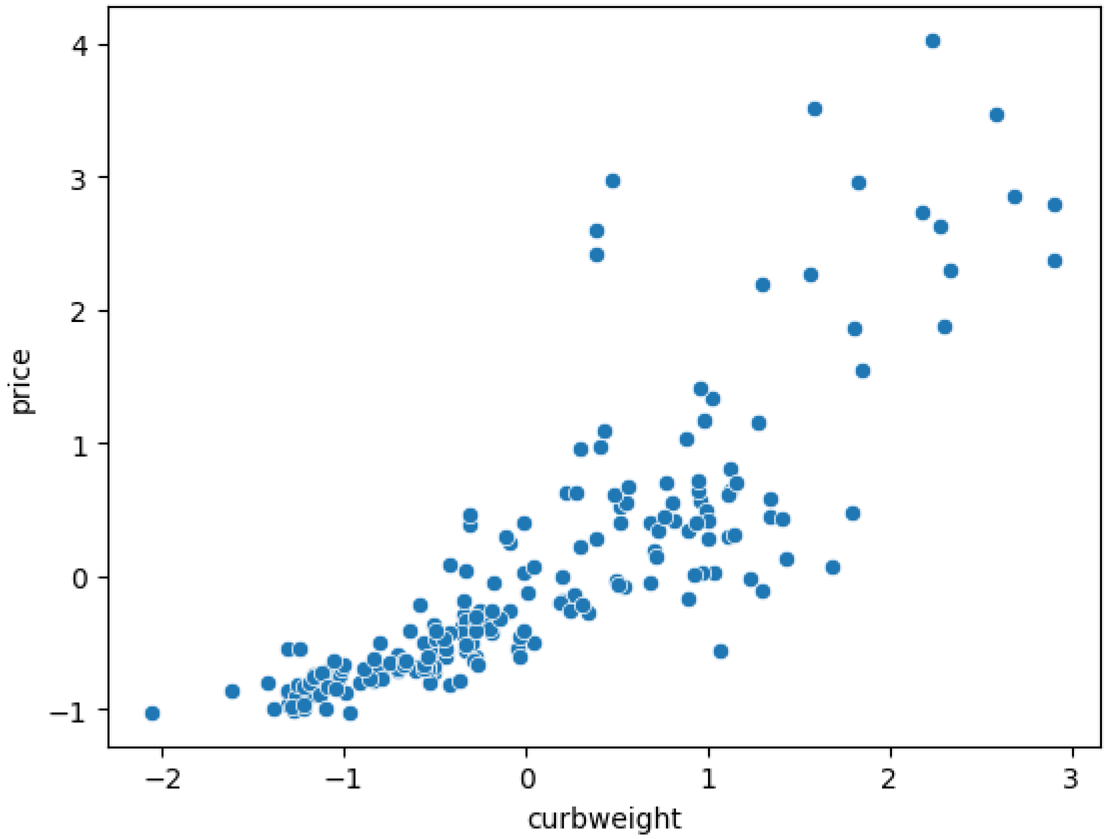


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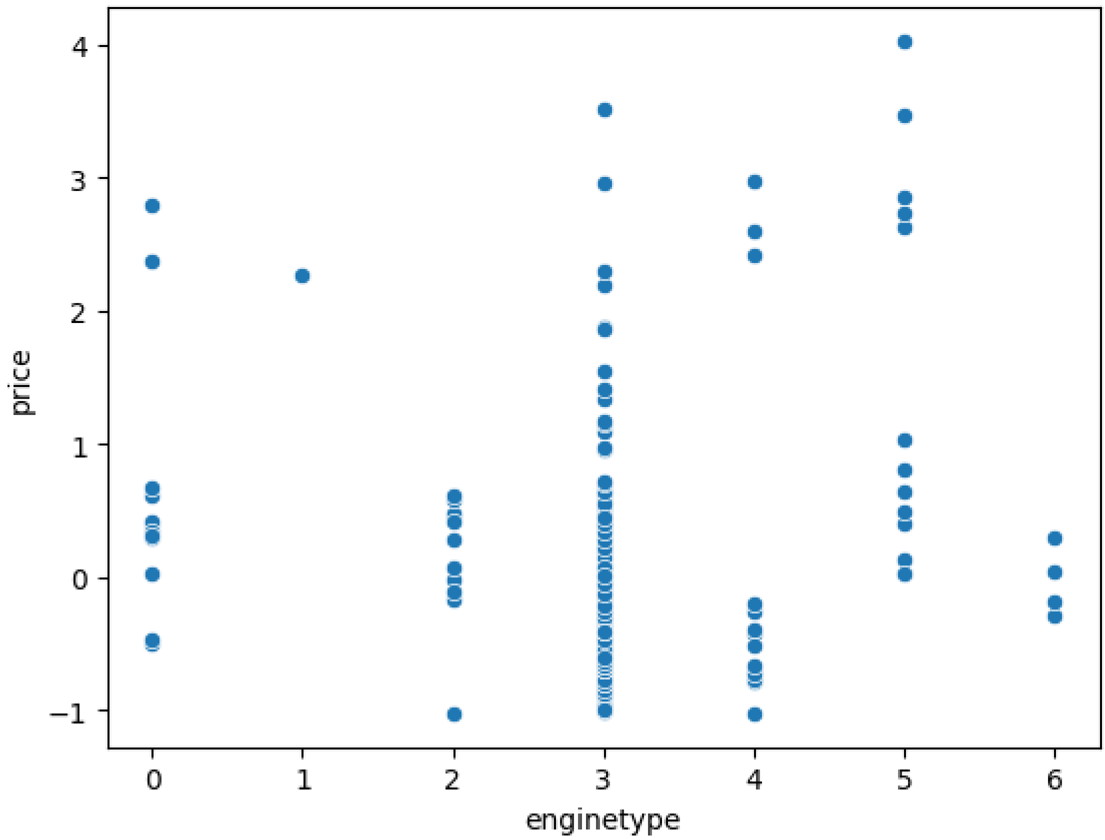


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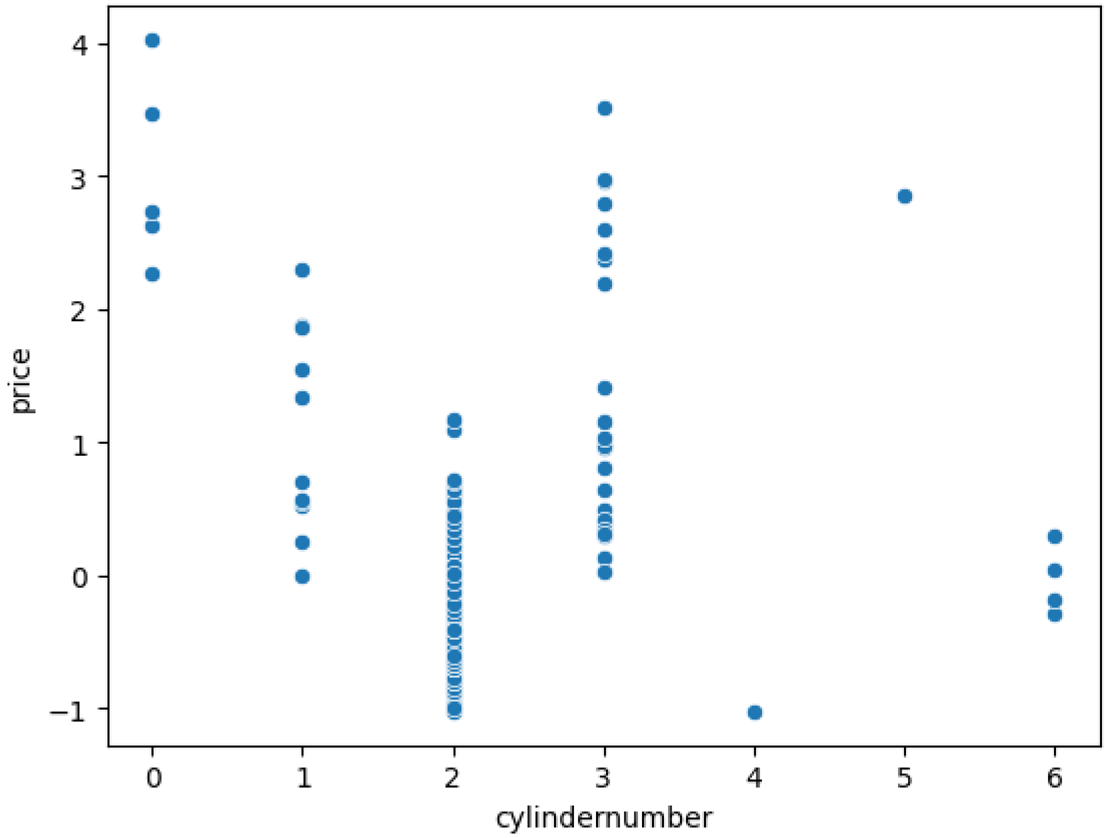

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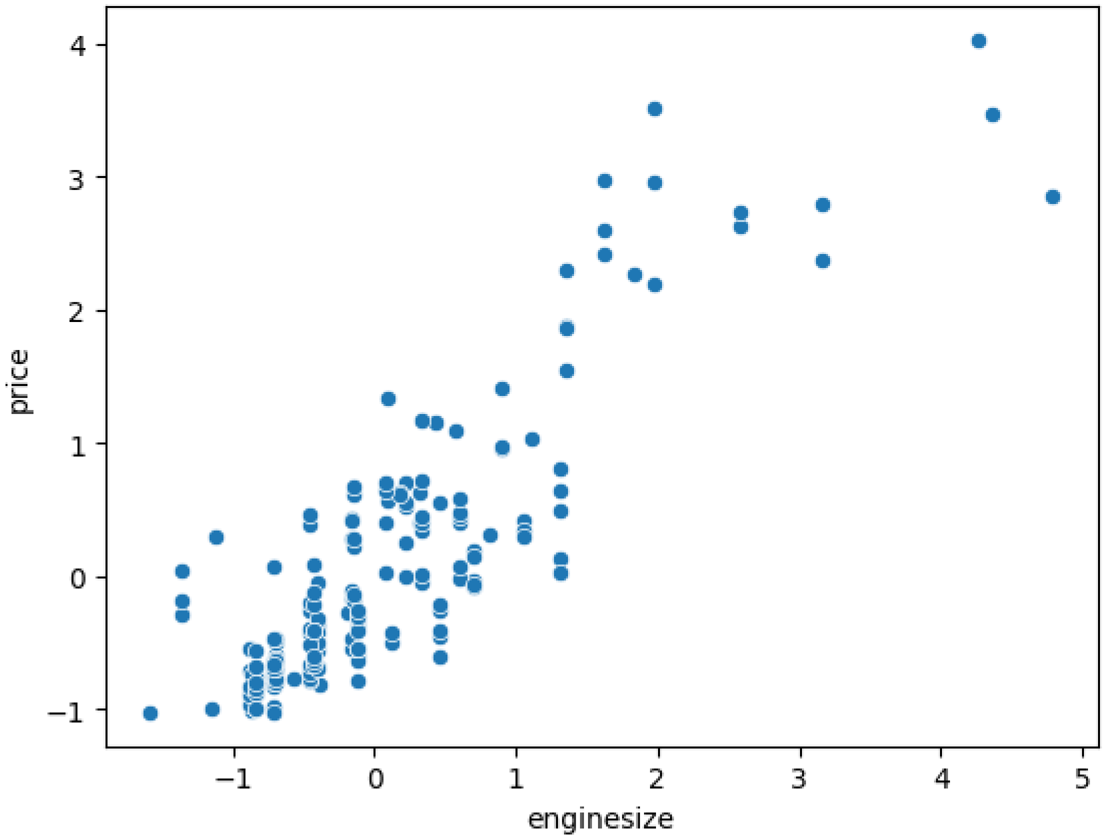


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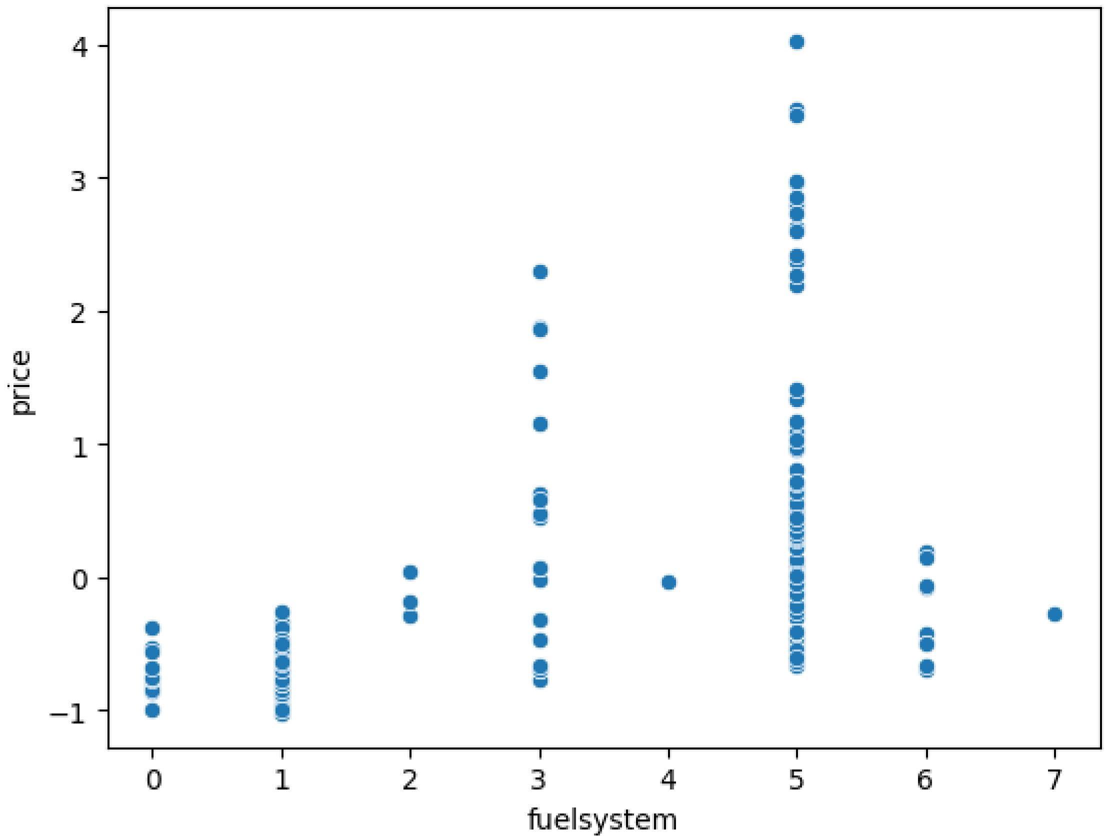


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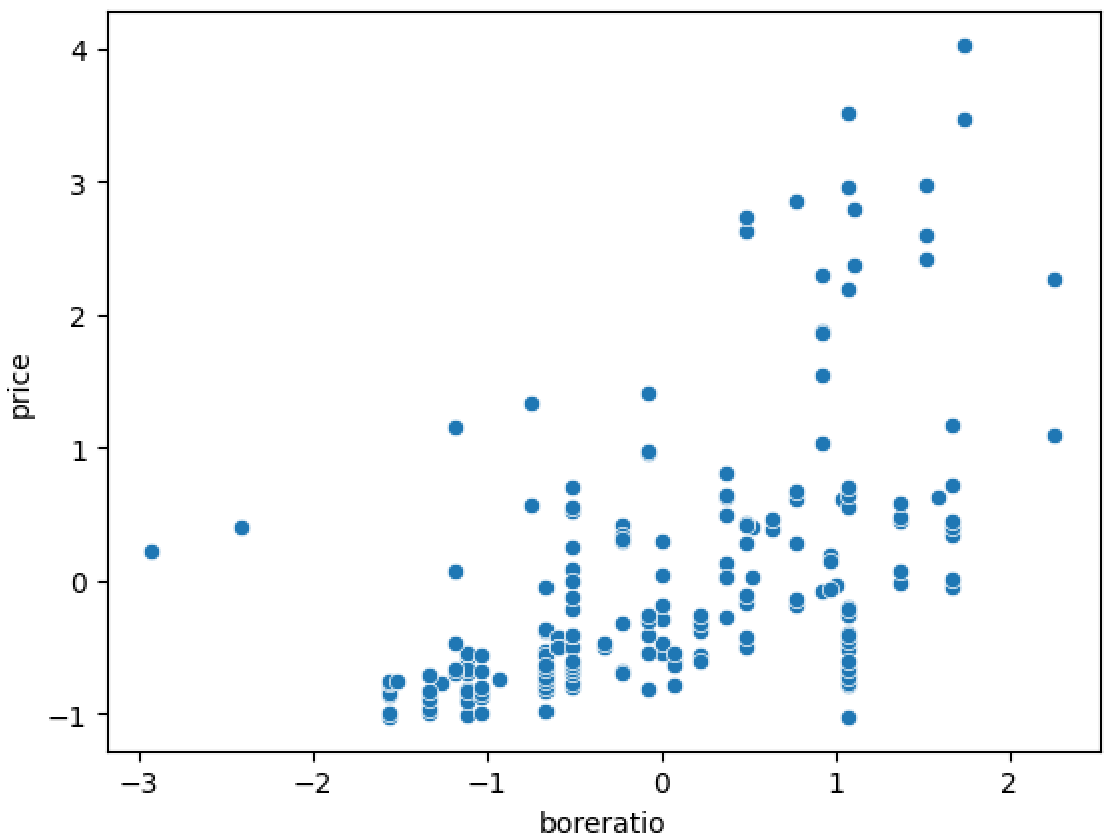

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```

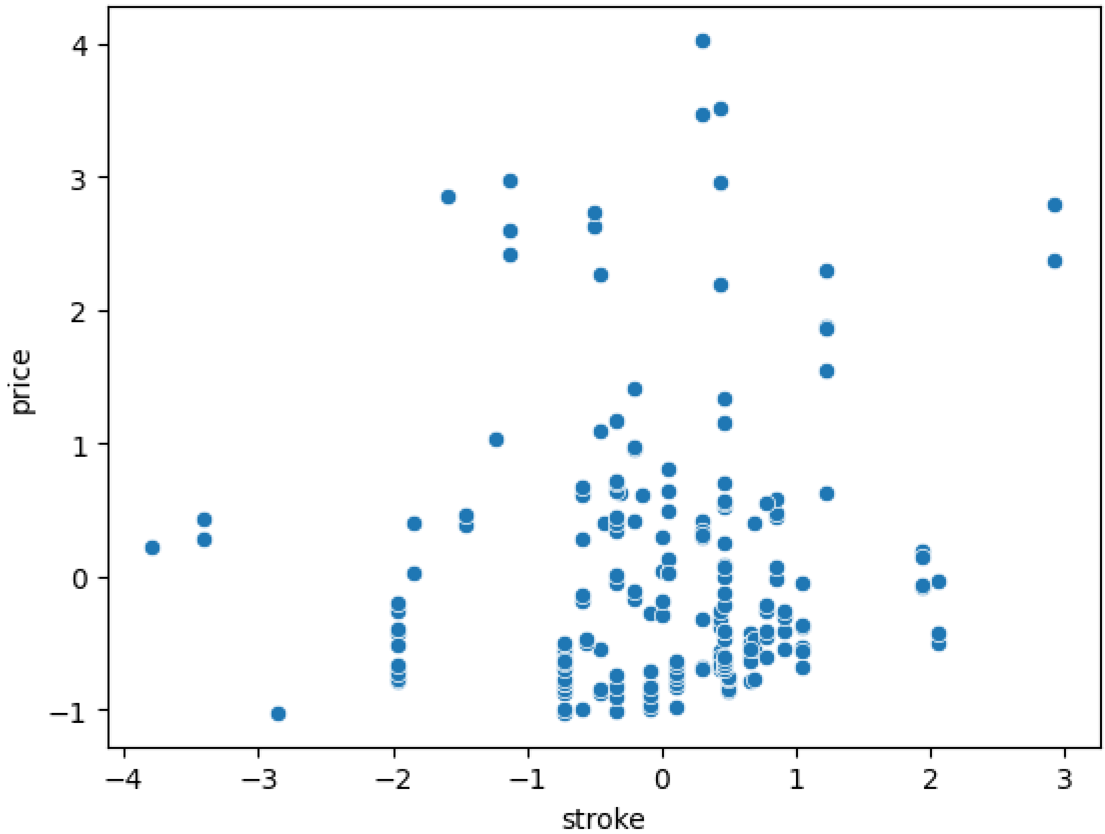


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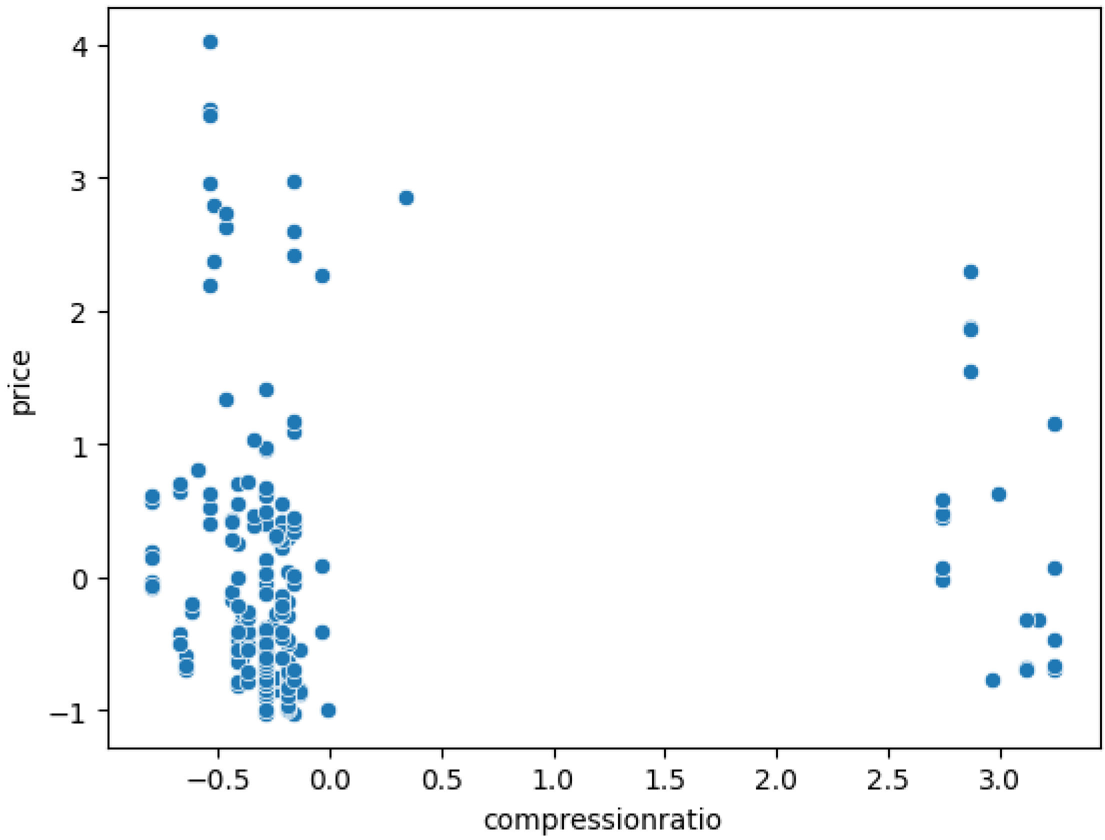


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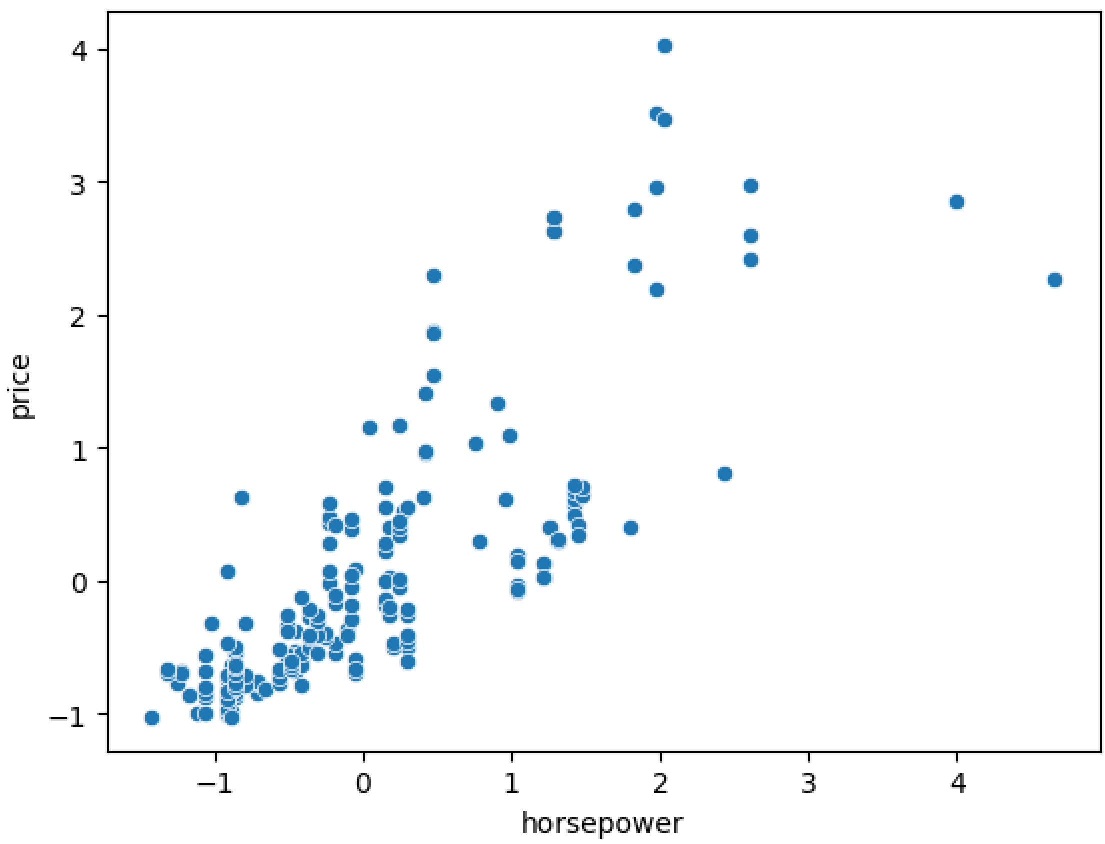

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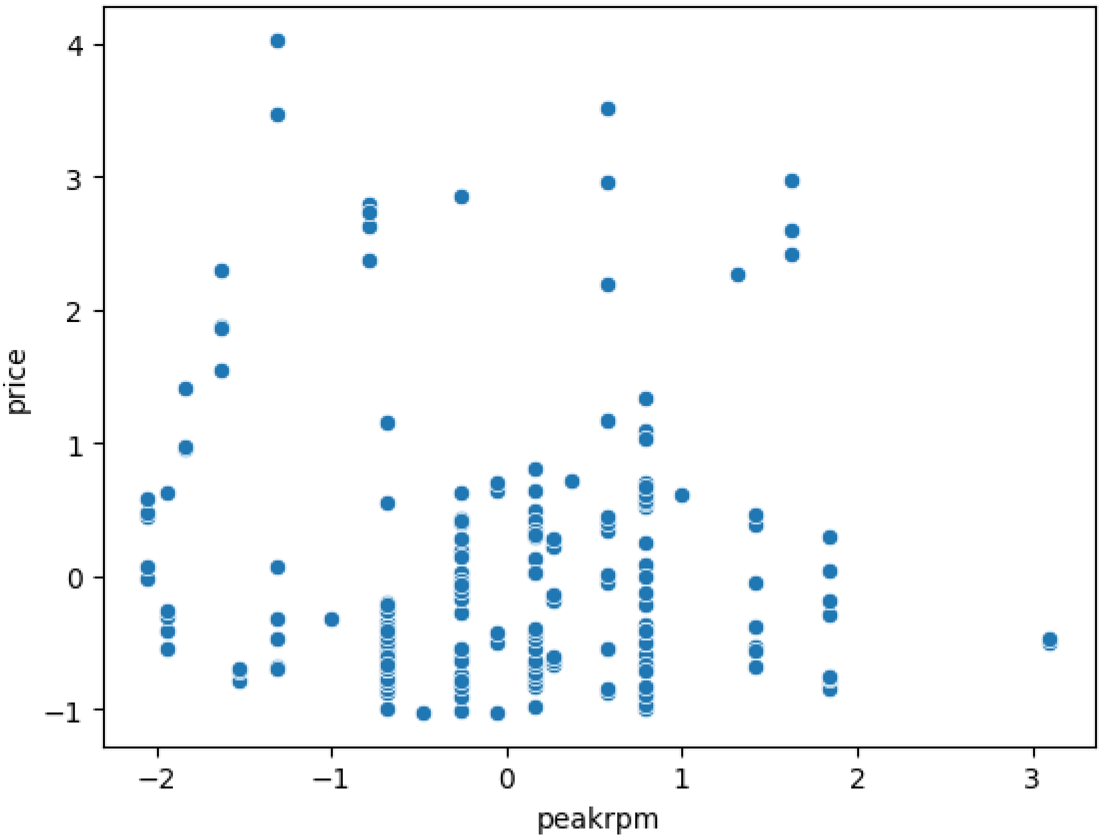


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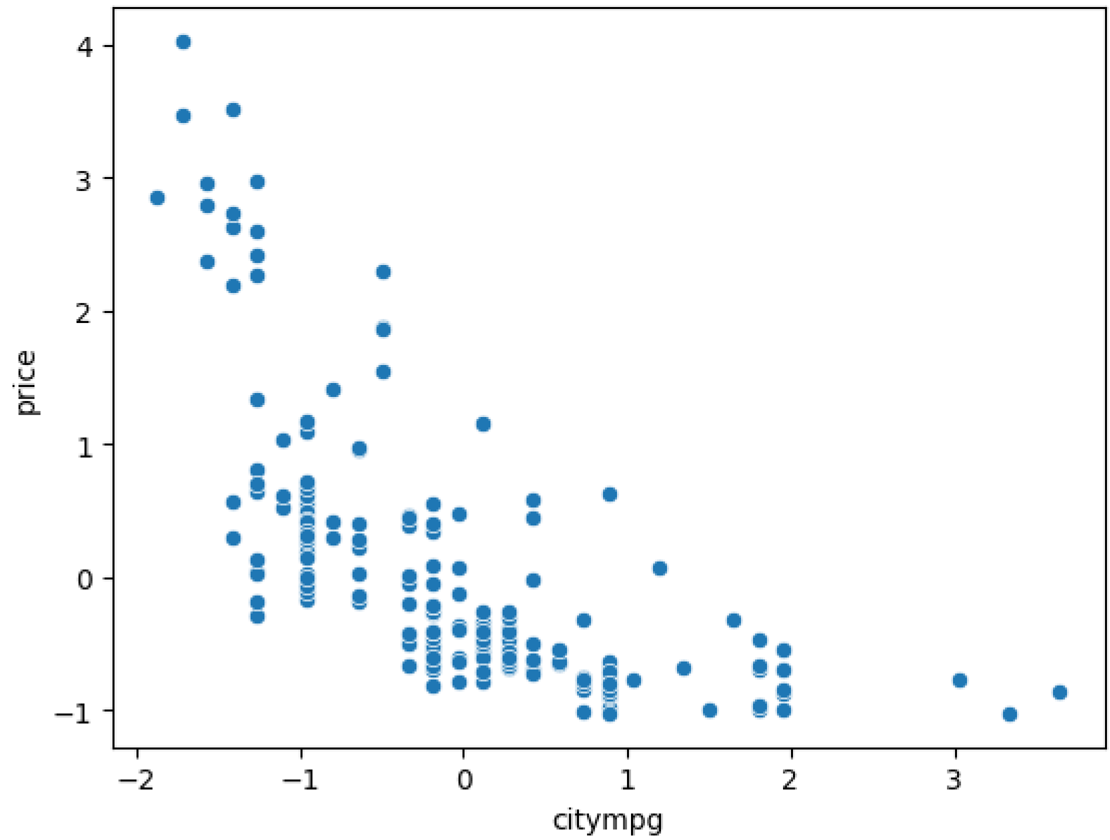


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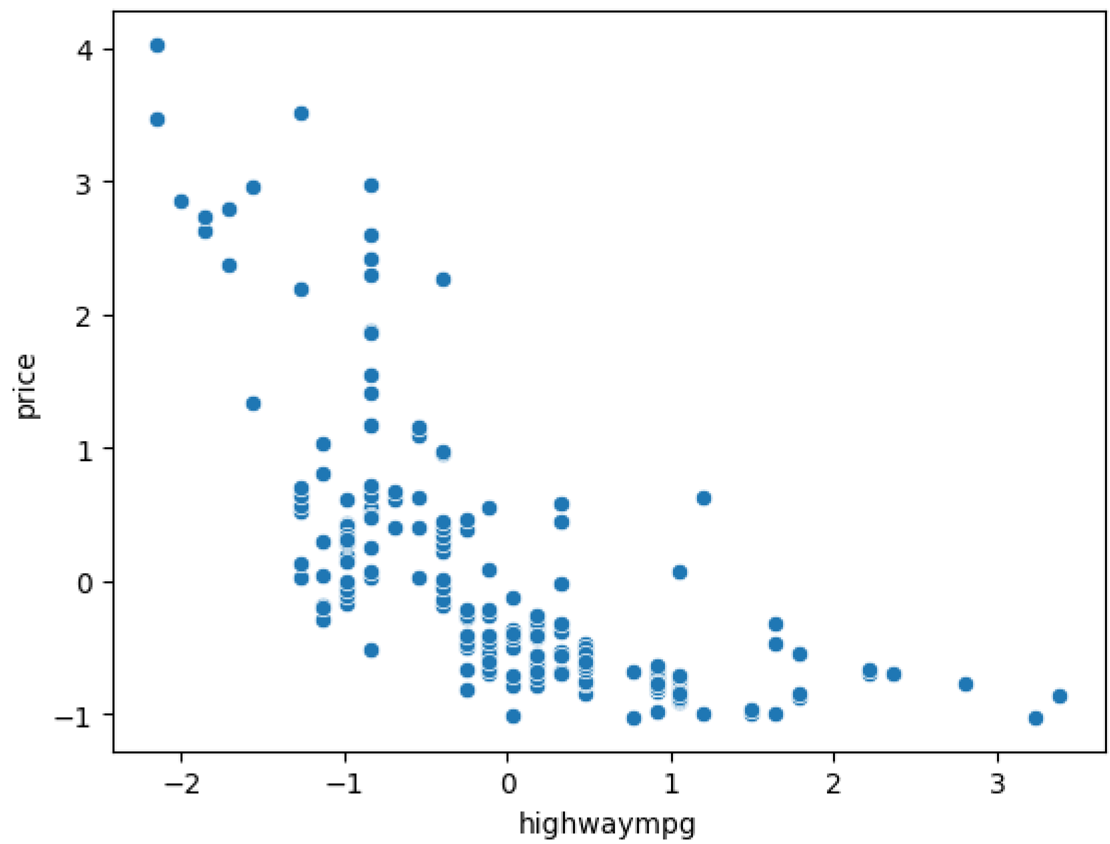

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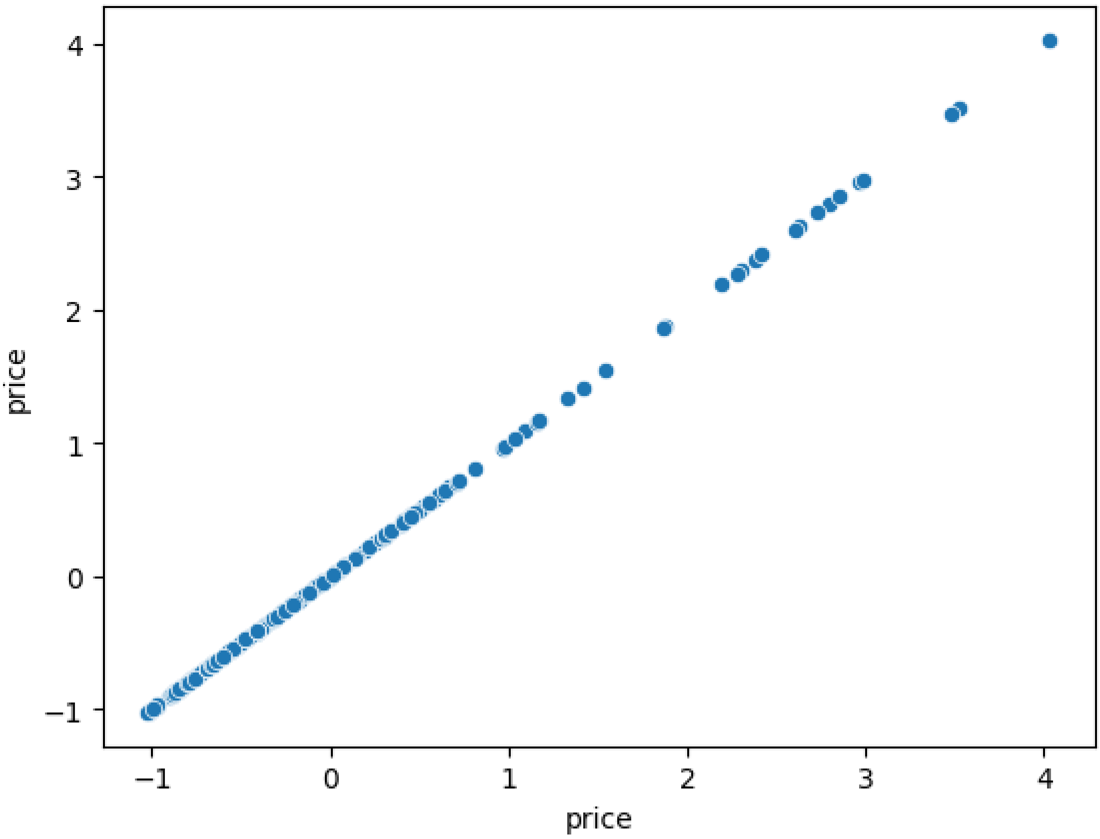
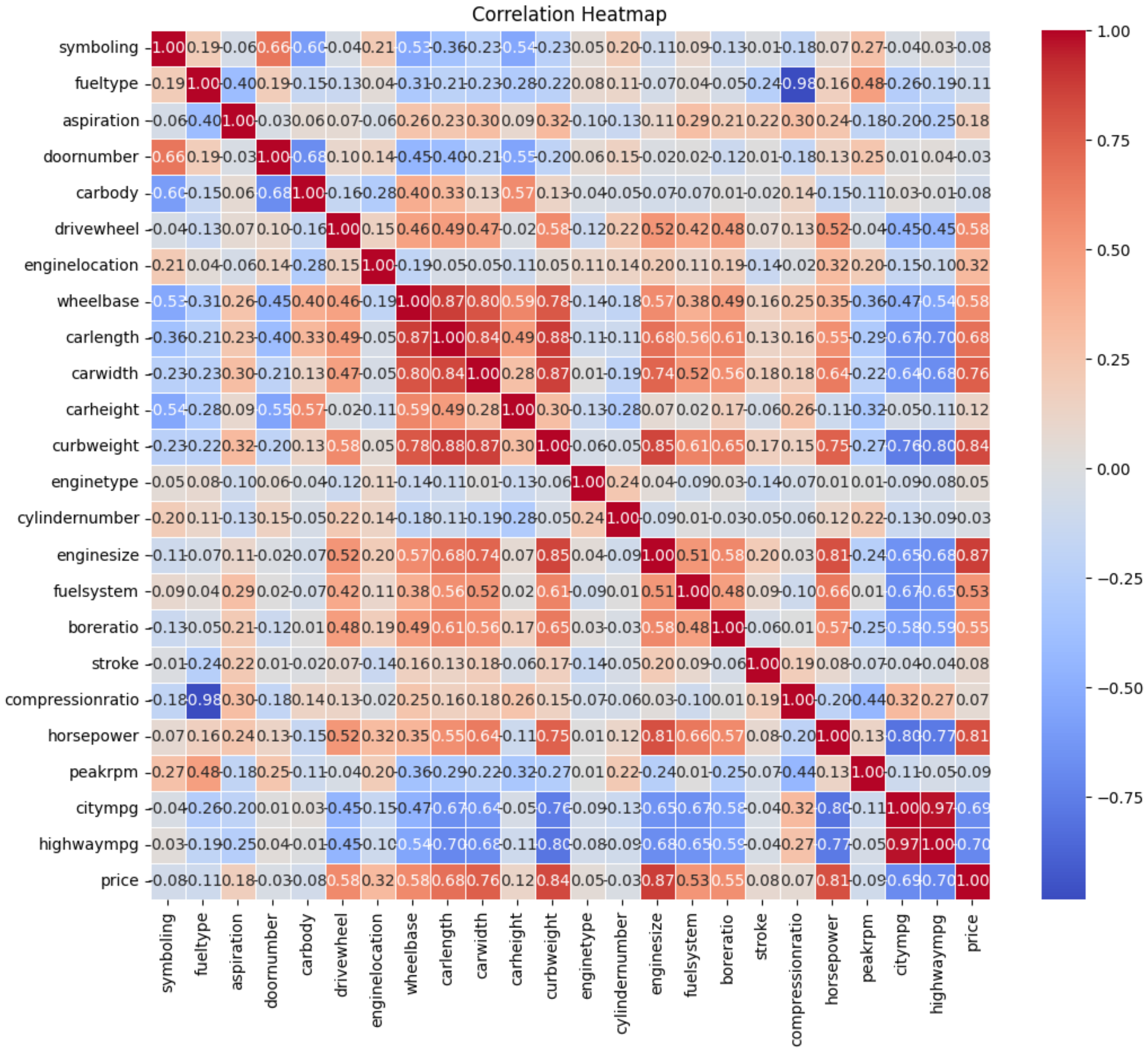


In [137…

```
# Creating a correlation matrix between numerical columns
correlation_matrix = df.corr()
plt.figure(figsize=(12, 10))
sns.heatmap(correlation_matrix, annot=True, cmap='coolwarm', fmt='.2f', linewidt
plt.title('Correlation Heatmap')
plt.show()
```



Observations from scatter plot and heatmap

The independent variables that affects the price of car are, 1.'drivewheel' 2.'wheelbase' 3.'carlength' 4.'carwidth' 5.'curbweight' 6.'cylindernumber' 7.'enginesize' 8.'fuelsystem' 9.'boreratio' 10.'horsepower' 11.'citympg' (negative correlation) 12.'highwaympg' (negative correlation)

In [138…
```
X = df[['drivewheel', 'wheelbase','carlength','carwidth','curbweight','cylinderr
y = df['price']
```

In [139…
```
from sklearn.model_selection import train_test_split
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, random_
```

Create a ML model for Car Price Prediction using Linear Regression-Multiple Variables

In [140…
```
#  LinearRegression
from sklearn.linear_model import LinearRegression
from sklearn.metrics import mean_absolute_error, mean_squared_error
```

In [141…
```
model = LinearRegression()
```

In [142...
```
# Train the model on the training data
model.fit(X_train, y_train)
```

Out[142]:
```
▾ LinearRegression
LinearRegression()
```

In [143...
```
y_pred = model.predict(X_test)
```

In [144...
```
mae = mean_absolute_error(y_test, y_pred)
mse = mean_squared_error(y_test, y_pred)
rmse = np.sqrt(mse)
```

In [145...
```
print("Mean Absolute Error:", mae)
print("Mean Squared Error:", mse)
print("Root Mean Squared Error:", rmse)
```

```
Mean Absolute Error: 0.3289440270311579
Mean Squared Error: 0.21397279772843472
Root Mean Squared Error: 0.46257193789553935
```

These metrics suggest that linear regression model is performing quite well. The lower values of MAE, MSE, and RMSE indicate that the model's predictions are accurate and close to the actual values.

In [ ]:
```

```