diction-oasis-infobyte-assignment

September 30, 2023

[1]:
```
from IPython import display
display.Image("/content/Banner.gif")
```

[1]:
```
<IPython.core.display.Image object>
```

1 Project Name : Car Price Prediction

AUTHOR : **Jamshed Butt** from **Data Science**

2 Import Libraries

[ ]:
```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
import scipy.stats as stats
import pylab

#Normalize Data
from sklearn.preprocessing import StandardScaler

#Conert Categorical to Numerical Value
from sklearn.preprocessing import LabelEncoder

#Columns Relationship for target value
from sklearn.feature_selection import mutual_info_classif,SelectKBest,f_classif

#Splitting Data
from sklearn.model_selection import train_test_split,cross_val_score

#PCA
from sklearn.decomposition import PCA

#Model
from sklearn.linear_model import LinearRegression
from sklearn.ensemble import RandomForestRegressor
```

```
from sklearn.tree import DecisionTreeRegressor
from sklearn.linear_model import Ridge


#Metrics
from sklearn.metrics import mean_absolute_error,mean_squared_error,r2_score
#from sklearn.metrics._plot.roc_curve import auc
```

3 Load Dataset

[ ]:
```
df = pd.read_csv("/content/drive/MyDrive/Datasets/CarPrice_Assignment.csv")
df.head()
```

[ ]:
```
   car_ID  symboling                   CarName fueltype aspiration doornumber  \
0       1          3        alfa-romero giulia      gas        std        two
1       2          3       alfa-romero stelvio      gas        std        two
2       3          1  alfa-romero Quadrifoglio      gas        std        two
3       4          2               audi 100 ls      gas        std       four
4       5          2                audi 100ls      gas        std       four

       carbody drivewheel enginelocation  wheelbase  …  enginesize  \
0  convertible        rwd          front       88.6  …         130
1  convertible        rwd          front       88.6  …         130
2    hatchback        rwd          front       94.5  …         152
3        sedan        fwd          front       99.8  …         109
4        sedan        4wd          front       99.4  …         136

   fuelsystem  boreratio  stroke compressionratio horsepower  peakrpm citympg  \
0        mpfi       3.47    2.68              9.0        111     5000       21
1        mpfi       3.47    2.68              9.0        111     5000       21
2        mpfi       2.68    3.47              9.0        154     5000       19
3        mpfi       3.19    3.40             10.0        102     5500       24
4        mpfi       3.19    3.40              8.0        115     5500       18

   highwaympg    price
0          27  13495.0
1          27  16500.0
2          26  16500.0
3          30  13950.0
4          22  17450.0

[5 rows x 26 columns]
```

[ ]:
```
df.shape
```

[ ]:
```
(205, 26)
```

[ ]:
```
df.columns
```

[ ]:
```
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')
```

[ ]:
```
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
```

[ ]:
```
df.describe()
```

[ ]:
```
            car_ID   symboling   wheelbase   carlength    carwidth   carheight  \
count   205.000000  205.000000  205.000000  205.000000  205.000000  205.000000
mean    103.000000    0.834146   98.756585  174.049268   65.907805   53.724878
std      59.322565    1.245307    6.021776   12.337289    2.145204    2.443522
min       1.000000   -2.000000   86.600000  141.100000   60.300000   47.800000
25%      52.000000    0.000000   94.500000  166.300000   64.100000   52.000000
50%     103.000000    1.000000   97.000000  173.200000   65.500000   54.100000
75%     154.000000    2.000000  102.400000  183.100000   66.900000   55.500000
max     205.000000    3.000000  120.900000  208.100000   72.300000   59.800000

          curbweight  enginesize   boreratio      stroke  compressionratio  \
count   205.000000  205.000000  205.000000  205.000000        205.000000
mean   2555.565854  126.907317    3.329756    3.255415         10.142537
std     520.680204   41.642693    0.270844    0.313597          3.972040
min    1488.000000   61.000000    2.540000    2.070000          7.000000
25%    2145.000000   97.000000    3.150000    3.110000          8.600000
50%    2414.000000  120.000000    3.310000    3.290000          9.000000
75%    2935.000000  141.000000    3.580000    3.410000          9.400000
max    4066.000000  326.000000    3.940000    4.170000         23.000000

        horsepower      peakrpm     citympg  highwaympg         price
count  205.000000   205.000000  205.000000  205.000000    205.000000
mean   104.117073  5125.121951   25.219512   30.751220  13276.710571
std     39.544167   476.985643    6.542142    6.886443   7988.852332
min     48.000000  4150.000000   13.000000   16.000000   5118.000000
25%     70.000000  4800.000000   19.000000   25.000000   7788.000000
50%     95.000000  5200.000000   24.000000   30.000000  10295.000000
75%    116.000000  5500.000000   30.000000   34.000000  16503.000000
max    288.000000  6600.000000   49.000000   54.000000  45400.000000
```

[ ]:
```
df["CarName"].value_counts()
```

[ ]:
```
toyota corona           6
toyota corolla          6
peugeot 504             6
subaru dl               4
mitsubishi mirage g4    3
                       ..
mazda glc 4             1
mazda rx2 coupe         1
maxda glc deluxe        1
maxda rx3               1
volvo 246               1
Name: CarName, Length: 147, dtype: int64
```

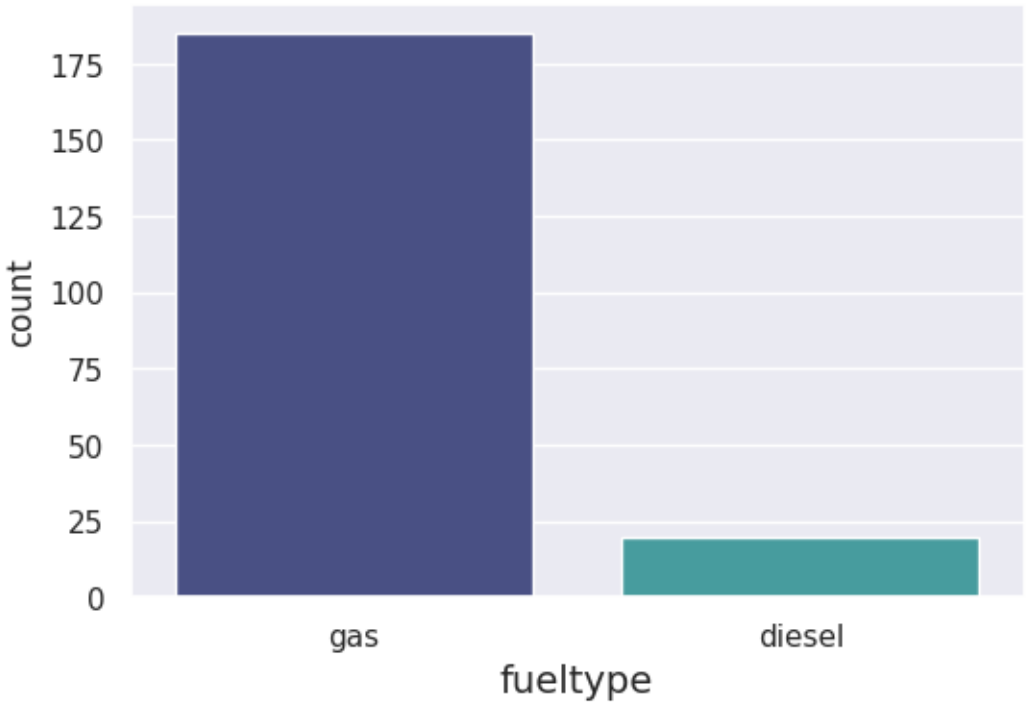
4 Univariate Analysis

[ ]:
```
df.info()
```

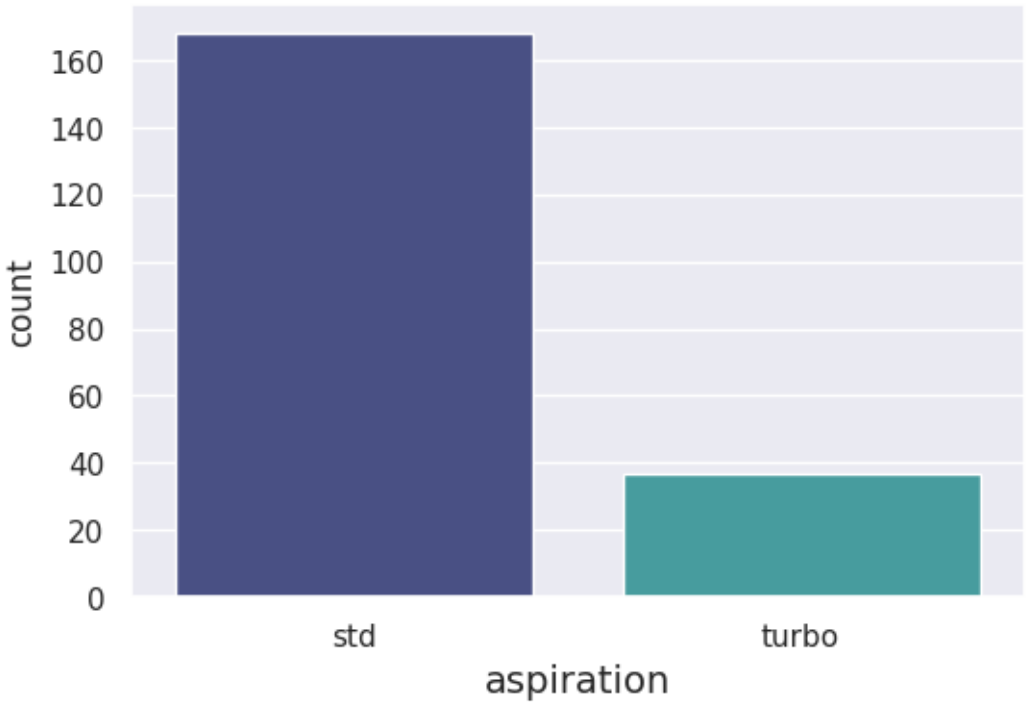
```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 205 entries, 0 to 204
Data columns (total 26 columns):
 #   Column            Non-Null Count  Dtype
---  ------            --------------  -----
 0   car_ID            205 non-null    int64
 1   symboling         205 non-null    int64
 2   CarName           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
```

Categorical Data

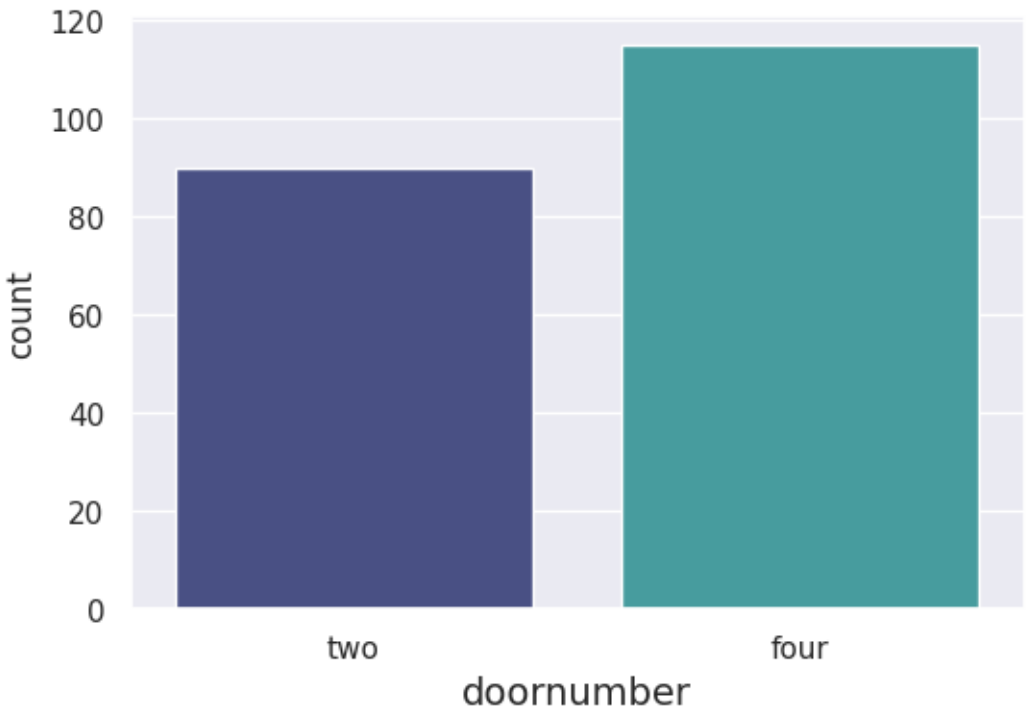
[ ]:
```
plt.figure(figsize=(6,4))
sns.countplot(x='fueltype' , data=df ,palette='mako')
plt.xlabel('fueltype', fontsize=14)
plt.show()
```



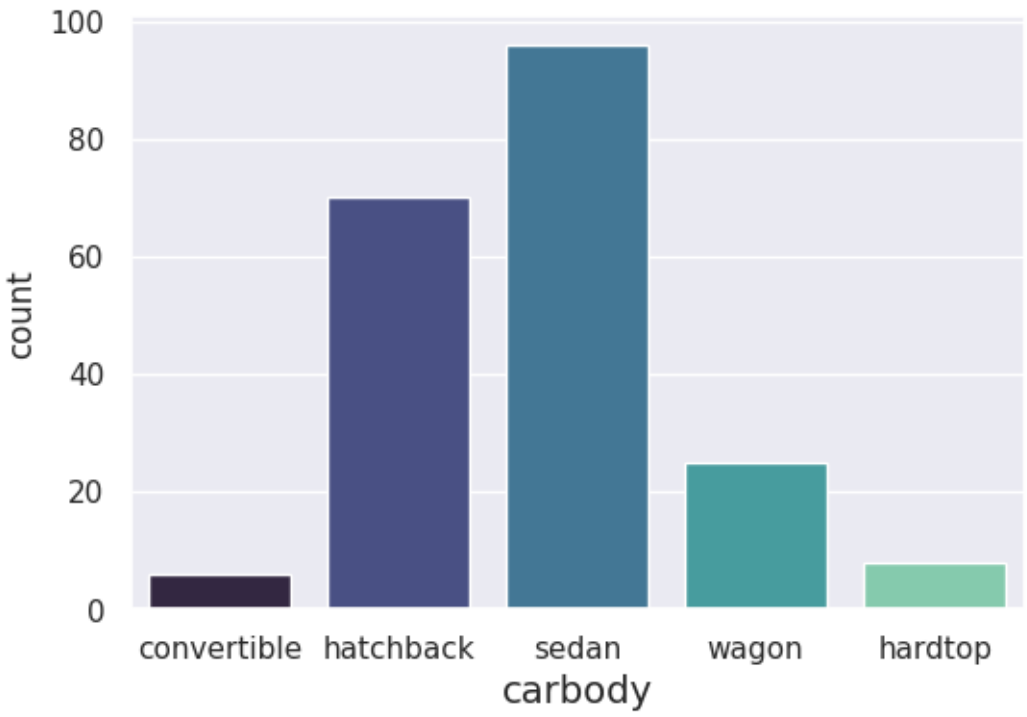
[ ]:
```
plt.figure(figsize=(6,4))
sns.countplot(x='aspiration' , data=df ,palette='mako')
plt.xlabel('aspiration', fontsize=14)
plt.show()
```



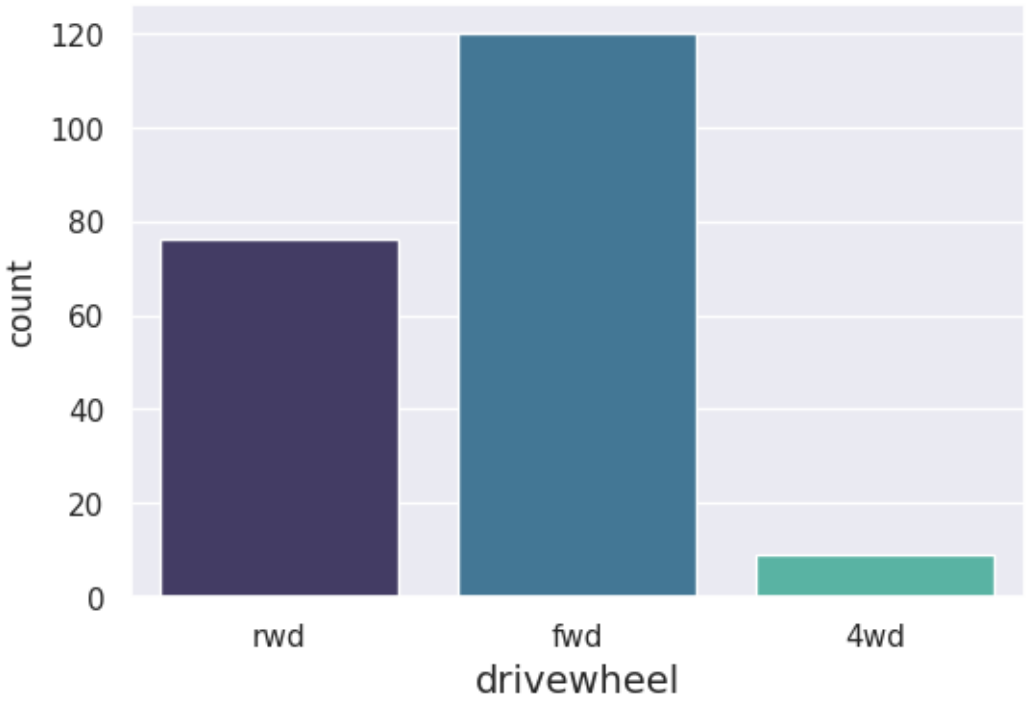
[ ]:
```
plt.figure(figsize=(6,4))
sns.countplot(x='doornumber' , data=df ,palette='mako')
plt.xlabel('doornumber', fontsize=14)
plt.show()
```



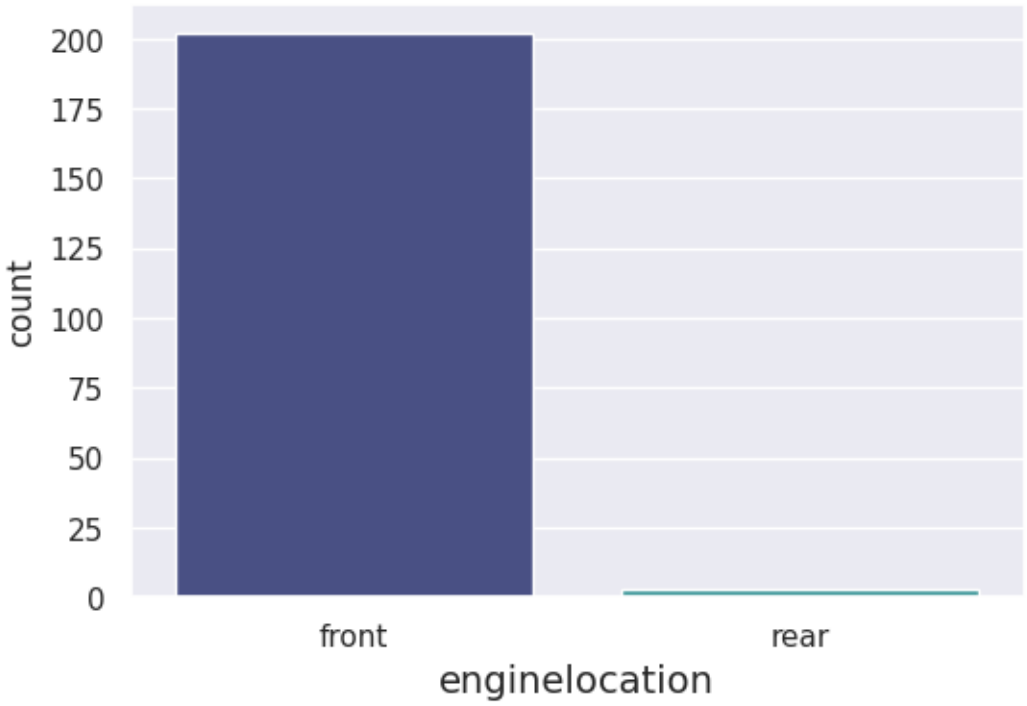
[ ]:
```
plt.figure(figsize=(6,4))
sns.countplot(x='carbody' , data=df ,palette='mako')
plt.xlabel('carbody', fontsize=14)
plt.show()
```



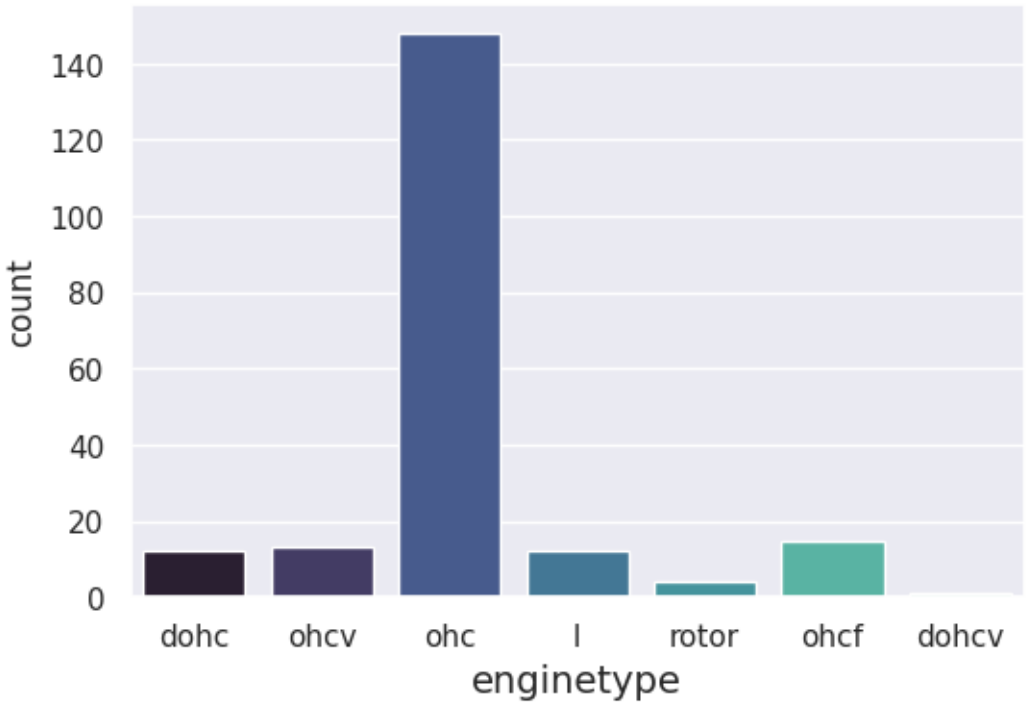
[ ]:
```
plt.figure(figsize=(6,4))
sns.countplot(x='drivewheel' , data=df ,palette='mako')
plt.xlabel('drivewheel', fontsize=14)
plt.show()
```



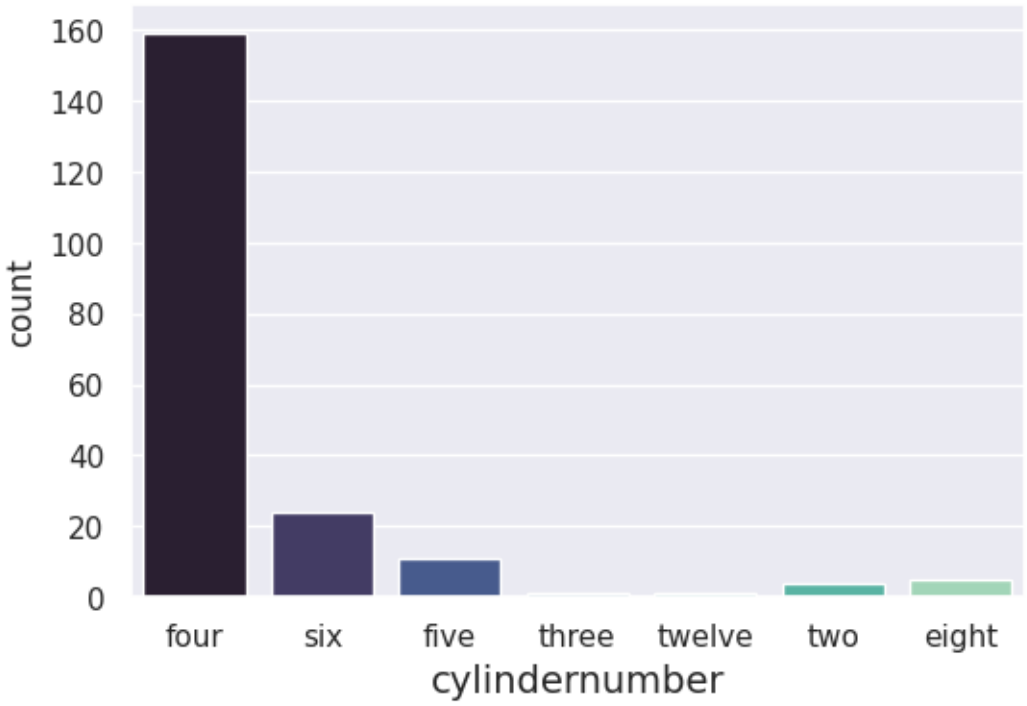
[ ]:
```
plt.figure(figsize=(6,4))
sns.countplot(x='enginelocation' , data=df ,palette='mako')
plt.xlabel('enginelocation', fontsize=14)
plt.show()
```



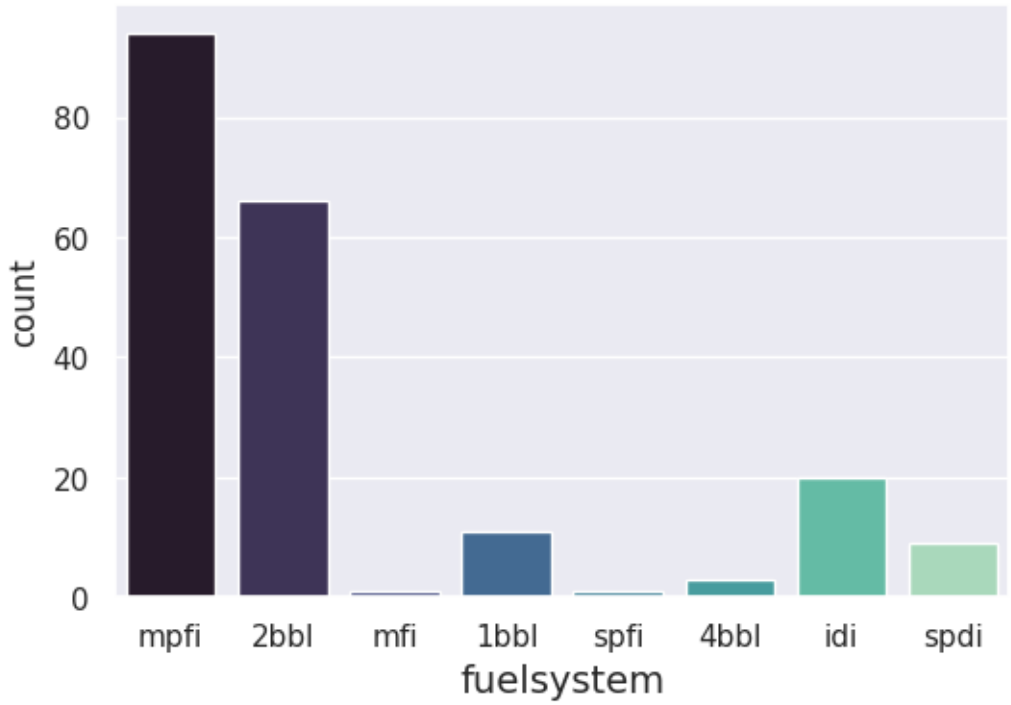
[ ]:
```
plt.figure(figsize=(6,4))
sns.countplot(x='enginetype' , data=df ,palette='mako')
plt.xlabel('enginetype', fontsize=14)
plt.show()
```



[ ]:
```
plt.figure(figsize=(6,4))
sns.countplot(x='cylindernumber' , data=df ,palette='mako')
plt.xlabel('cylindernumber', fontsize=14)
plt.show()
```



[ ]:
```
plt.figure(figsize=(6,4))
sns.countplot(x='fuelsystem' , data=df ,palette='mako')
plt.xlabel('fuelsystem', fontsize=14)
plt.show()
```

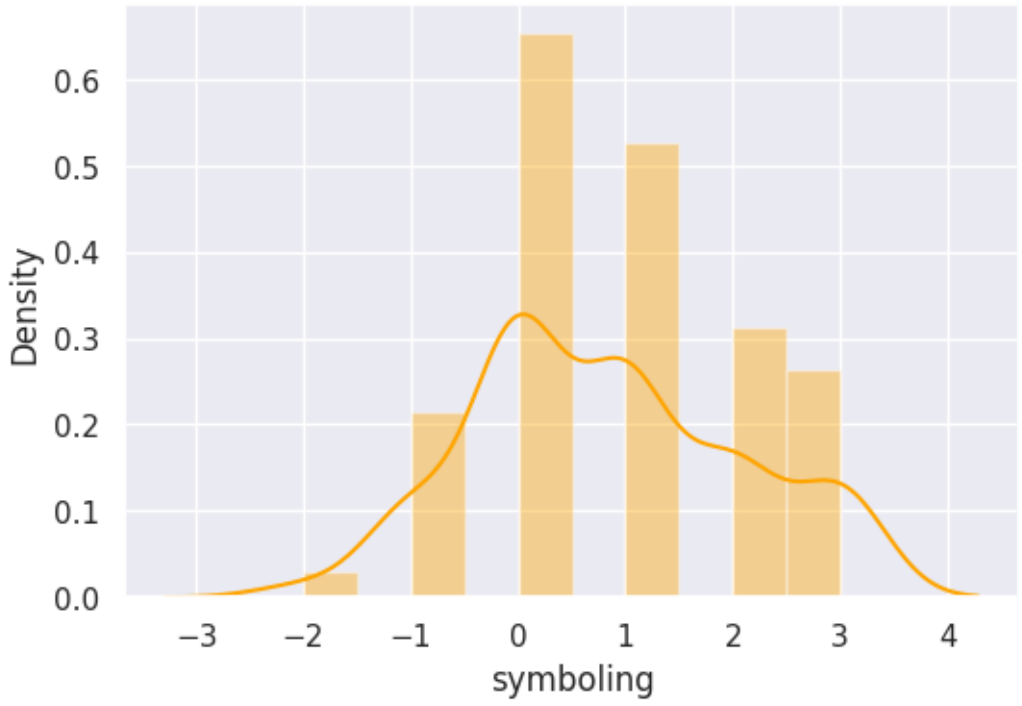


Numerical Data

[ ]:
```
sns.set(rc={"figure.figsize":(6,4)})
sns.distplot(df["symboling"], kde=True, color="orange", bins=10)
```

```
<ipython-input-254-abac86350aed>:2: UserWarning:

`distplot` is a deprecated function and will be removed in seaborn v0.14.0.

Please adapt your code to use either `displot` (a figure-level function with
similar flexibility) or `histplot` (an axes-level function for histograms).

For a guide to updating your code to use the new functions, please see
https://gist.github.com/mwaskom/de44147ed2974457ad6372750bbe5751

  sns.distplot(df["symboling"], kde=True, color="orange", bins=10)
```

[ ]:
```
<Axes: xlabel='symboling', ylabel='Density'>
```



[ ]:
```
sns.set(rc={"figure.figsize":(6,4)})
sns.distplot(df["wheelbase"], kde=True, color="orange", bins=10)
```

```
<ipython-input-255-c02d41bbd045>:2: UserWarning:

`distplot` is a deprecated function and will be removed in seaborn v0.14.0.

Please adapt your code to use either `displot` (a figure-level function with
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https://gist.github.com/mwaskom/de44147ed2974457ad6372750bbe5751

  sns.distplot(df["wheelbase"], kde=True, color="orange", bins=10)
```
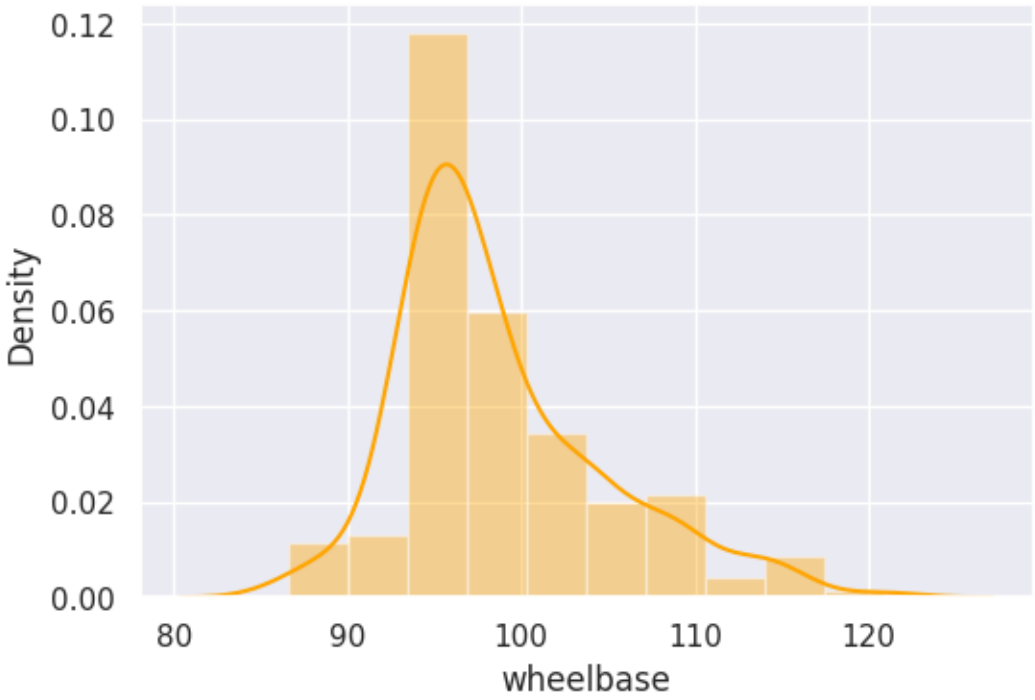

[ ]:
```
<Axes: xlabel='wheelbase', ylabel='Density'>
```



[ ]:
```
sns.set(rc={"figure.figsize":(6,4)})
sns.distplot(df["carlength"], kde=True, color="orange", bins=10)
```

```
<ipython-input-256-1ec7de8e8cab>:2: UserWarning:

`distplot` is a deprecated function and will be removed in seaborn v0.14.0.

Please adapt your code to use either `displot` (a figure-level function with
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  sns.distplot(df["carlength"], kde=True, color="orange", bins=10)
```
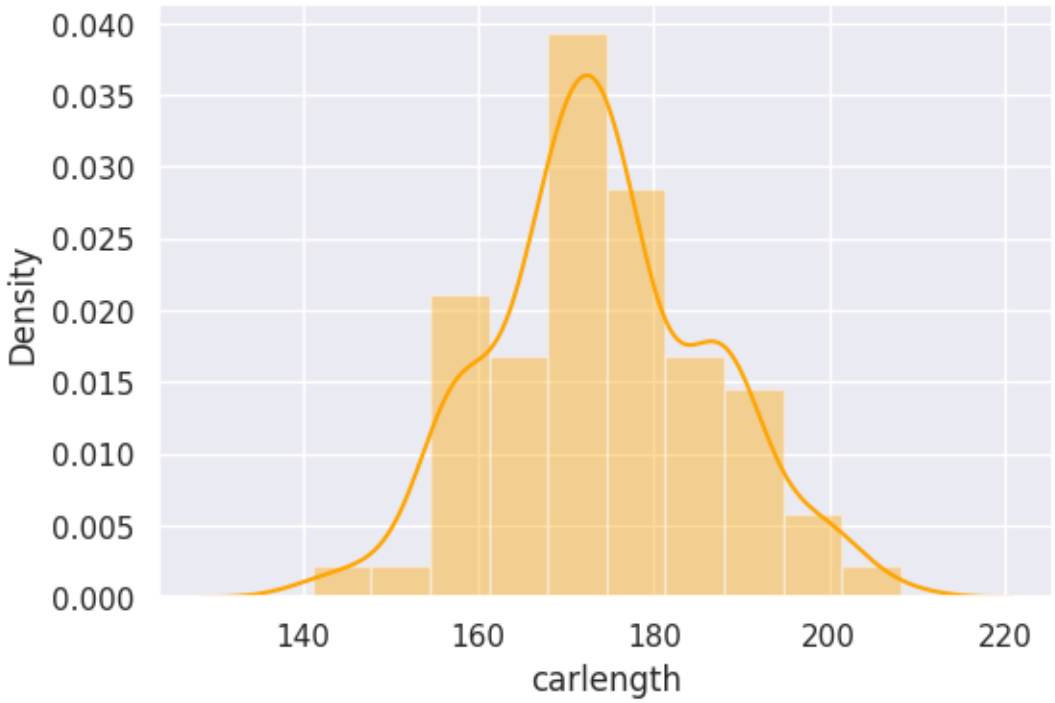

[ ]:
```
<Axes: xlabel='carlength', ylabel='Density'>
```



[ ]:
```
sns.set(rc={"figure.figsize":(6,4)})
sns.distplot(df["carwidth"], kde=True, color="orange", bins=10)
```

```
<ipython-input-257-84f1c82220a3>:2: UserWarning:

`distplot` is a deprecated function and will be removed in seaborn v0.14.0.

Please adapt your code to use either `displot` (a figure-level function with
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https://gist.github.com/mwaskom/de44147ed2974457ad6372750bbe5751

  sns.distplot(df["carwidth"], kde=True, color="orange", bins=10)
```
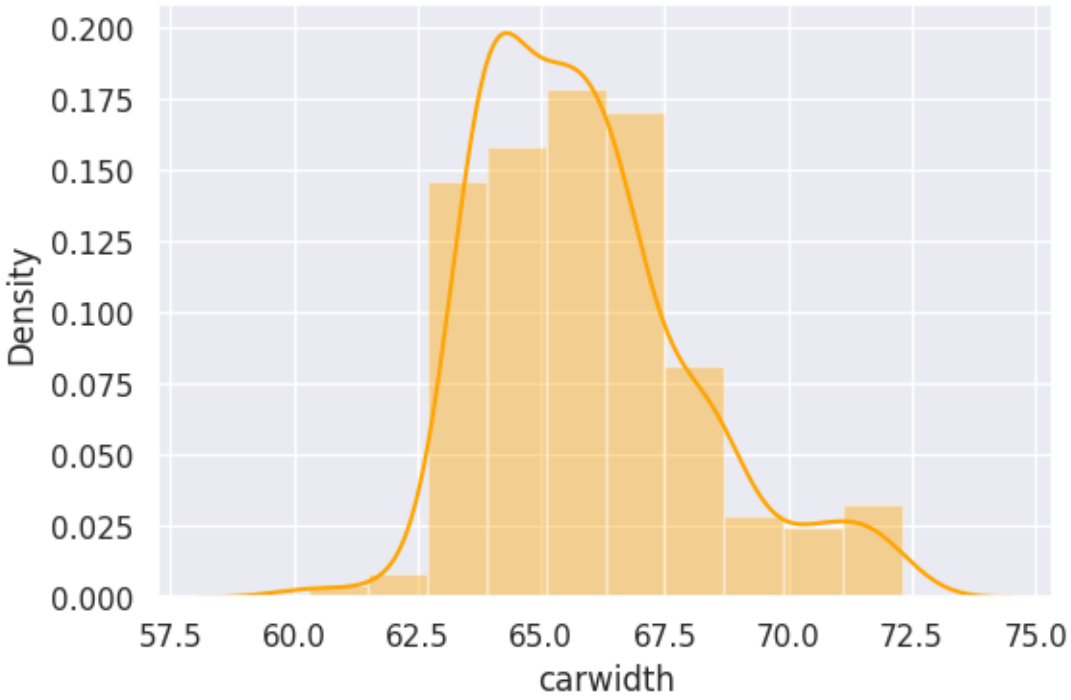

[ ]:
```
<Axes: xlabel='carwidth', ylabel='Density'>
```



[ ]:
```
sns.set(rc={"figure.figsize":(6,4)})
sns.distplot(df["carheight"], kde=True, color="orange", bins=10)
```

```
<ipython-input-258-3a91cc5beecd>:2: UserWarning:

`distplot` is a deprecated function and will be removed in seaborn v0.14.0.

Please adapt your code to use either `displot` (a figure-level function with
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  sns.distplot(df["carheight"], kde=True, color="orange", bins=10)
```
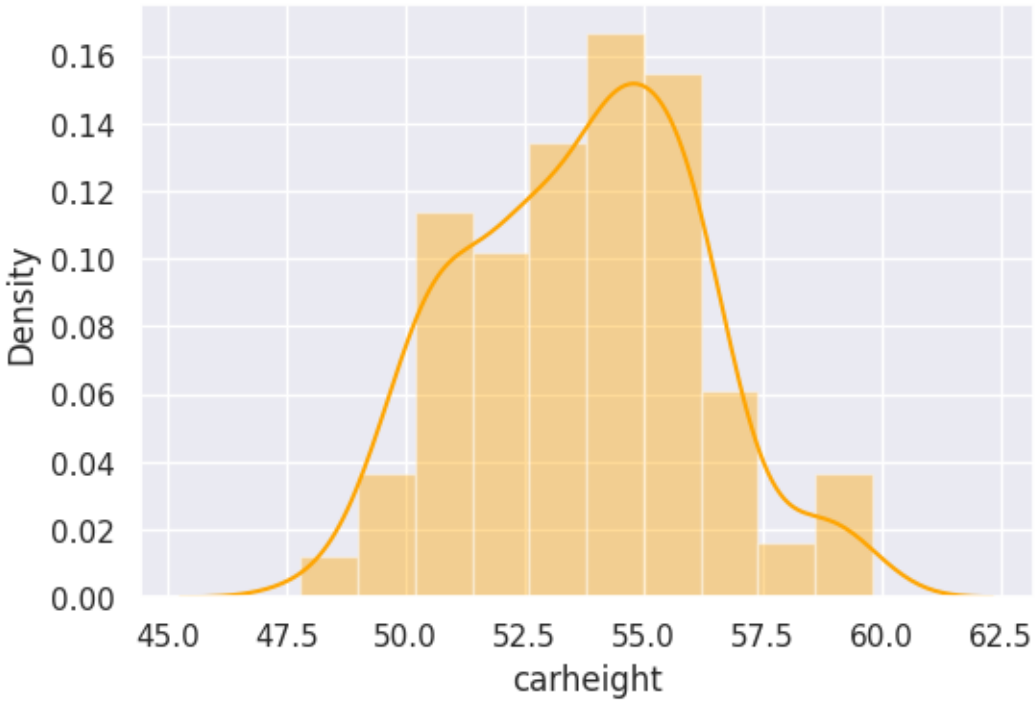

[ ]:
```
<Axes: xlabel='carheight', ylabel='Density'>
```



[ ]:
```
sns.set(rc={"figure.figsize":(6,4)})
sns.distplot(df["curbweight"], kde=True, color="orange", bins=10)
```

```
<ipython-input-259-deab17bd35f5>:2: UserWarning:

`distplot` is a deprecated function and will be removed in seaborn v0.14.0.

Please adapt your code to use either `displot` (a figure-level function with
similar flexibility) or `histplot` (an axes-level function for histograms).

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https://gist.github.com/mwaskom/de44147ed2974457ad6372750bbe5751

  sns.distplot(df["curbweight"], kde=True, color="orange", bins=10)
```
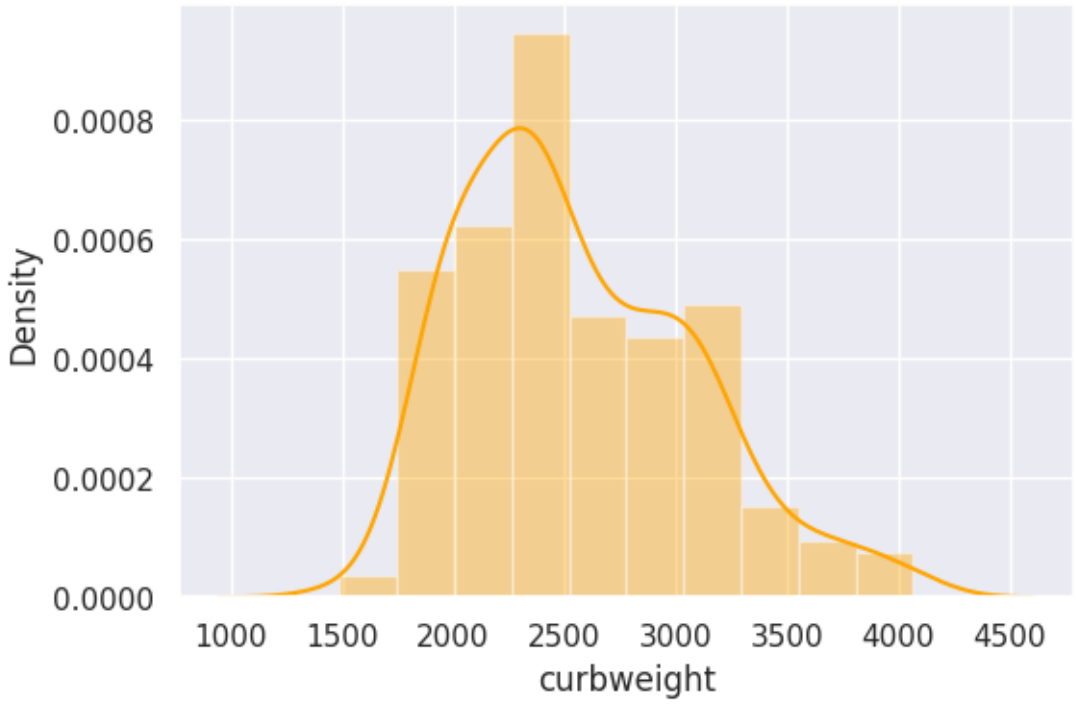
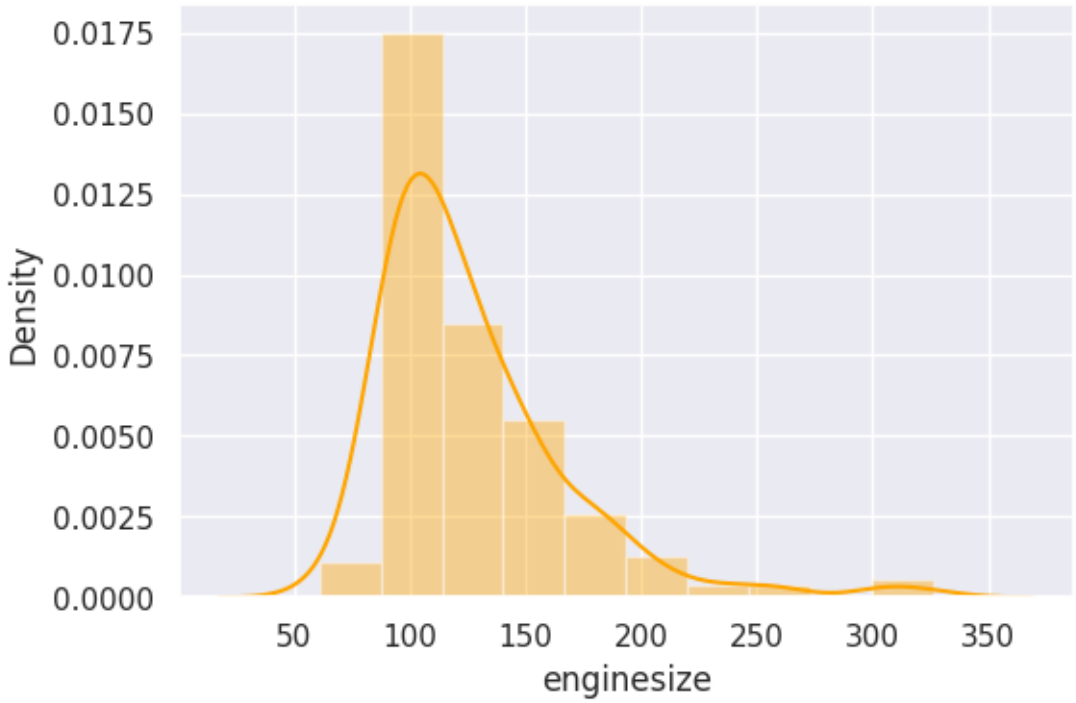

[ ]:
```
<Axes: xlabel='curbweight', ylabel='Density'>
```



[ ]:
```
sns.set(rc={"figure.figsize":(6,4)})
sns.distplot(df["enginesize"], kde=True, color="orange", bins=10)
```

```
<ipython-input-260-06ba97e738c6>:2: UserWarning:

`distplot` is a deprecated function and will be removed in seaborn v0.14.0.

Please adapt your code to use either `displot` (a figure-level function with
similar flexibility) or `histplot` (an axes-level function for histograms).

For a guide to updating your code to use the new functions, please see
https://gist.github.com/mwaskom/de44147ed2974457ad6372750bbe5751

  sns.distplot(df["enginesize"], kde=True, color="orange", bins=10)
```

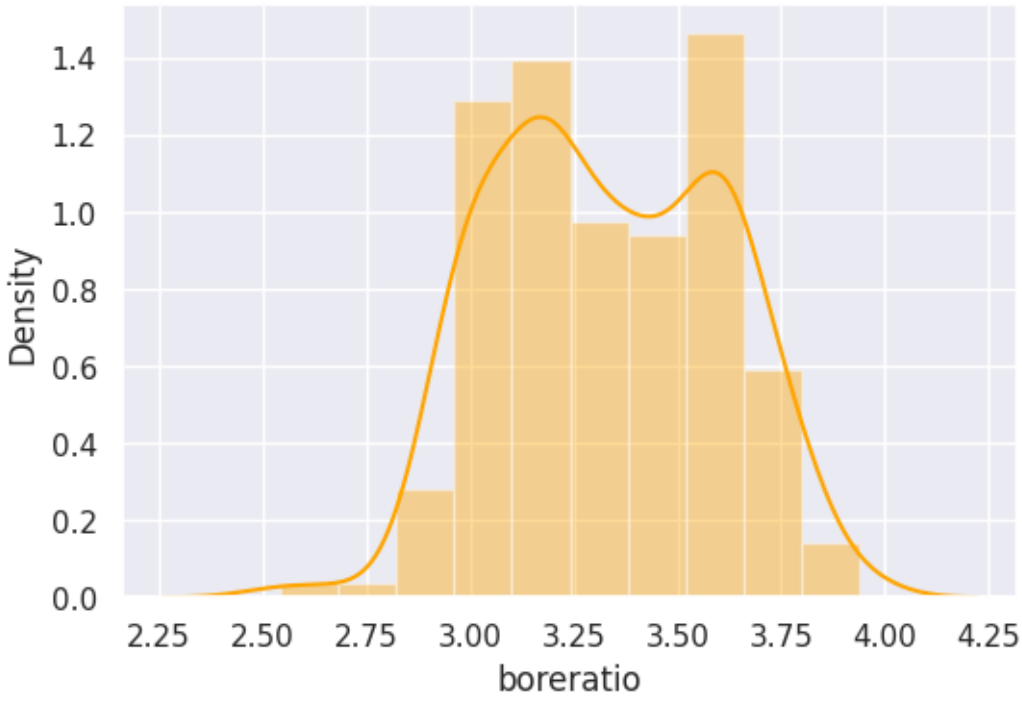
[ ]:
```
<Axes: xlabel='enginesize', ylabel='Density'>
```



[ ]:
```
sns.set(rc={"figure.figsize":(6,4)})
sns.distplot(df["boreratio"], kde=True, color="orange", bins=10)
```

```
<ipython-input-261-4bf018894454>:2: UserWarning:

`distplot` is a deprecated function and will be removed in seaborn v0.14.0.

Please adapt your code to use either `displot` (a figure-level function with
similar flexibility) or `histplot` (an axes-level function for histograms).

For a guide to updating your code to use the new functions, please see
https://gist.github.com/mwaskom/de44147ed2974457ad6372750bbe5751

  sns.distplot(df["boreratio"], kde=True, color="orange", bins=10)
```

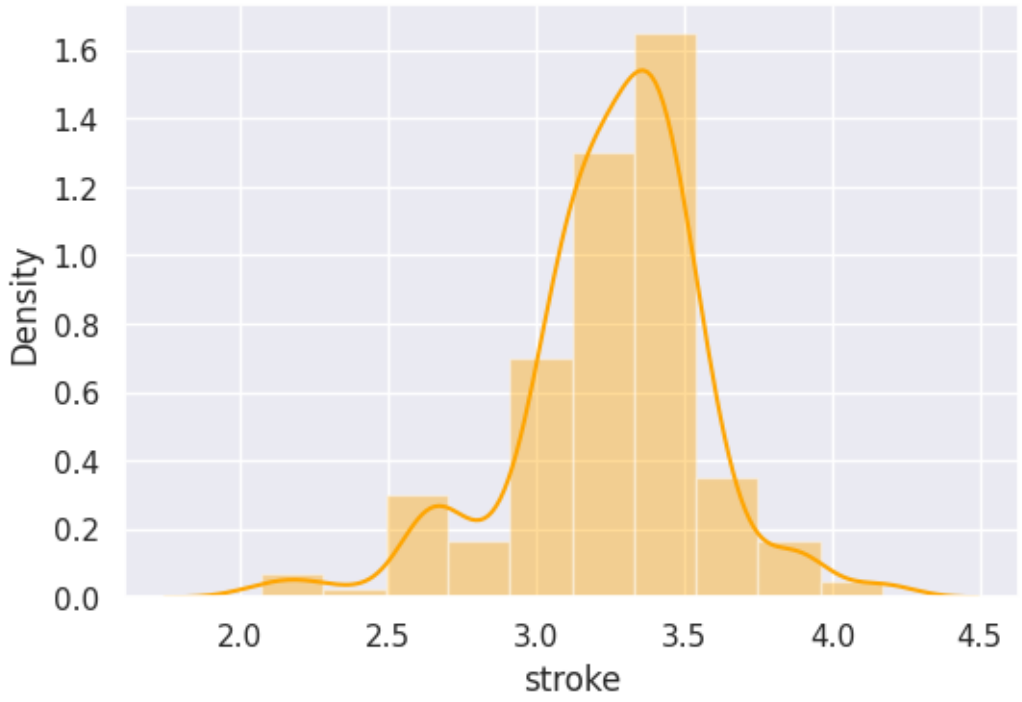
[ ]:
```
<Axes: xlabel='boreratio', ylabel='Density'>
```



[ ]:
```
sns.set(rc={"figure.figsize":(6,4)})
sns.distplot(df["stroke"], kde=True, color="orange", bins=10)
```

```
<ipython-input-262-1e3936c3f84c>:2: UserWarning:

`distplot` is a deprecated function and will be removed in seaborn v0.14.0.

Please adapt your code to use either `displot` (a figure-level function with
similar flexibility) or `histplot` (an axes-level function for histograms).

For a guide to updating your code to use the new functions, please see
https://gist.github.com/mwaskom/de44147ed2974457ad6372750bbe5751

  sns.distplot(df["stroke"], kde=True, color="orange", bins=10)
```

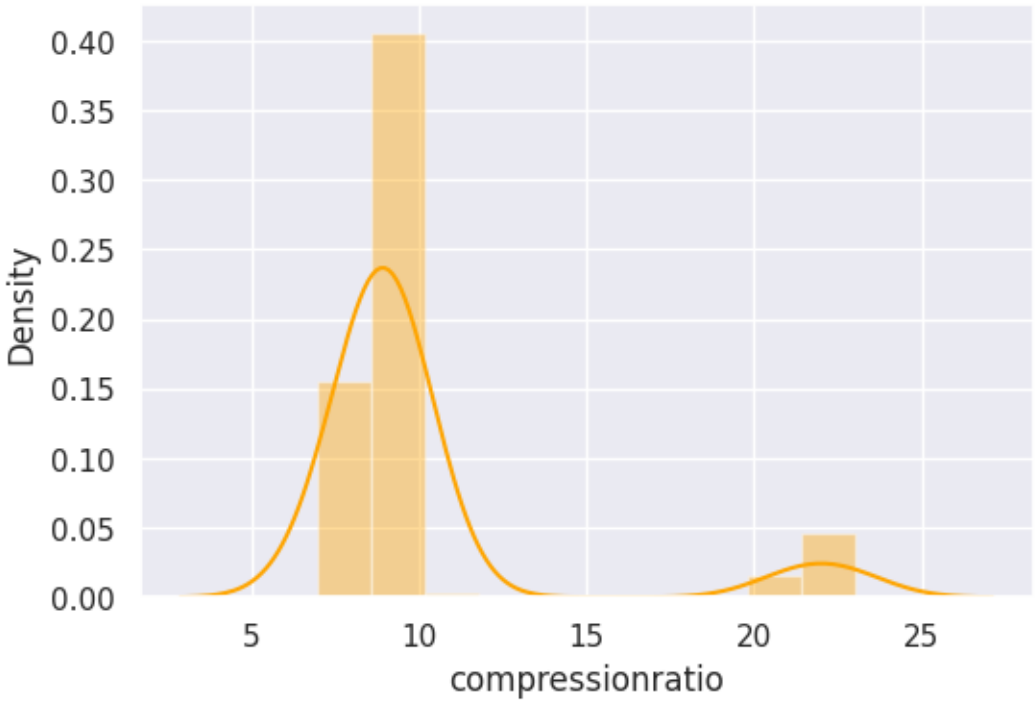
[ ]:
```
<Axes: xlabel='stroke', ylabel='Density'>
```



[ ]:
```
sns.set(rc={"figure.figsize":(6,4)})
sns.distplot(df["compressionratio"], kde=True, color="orange", bins=10)
```

```
<ipython-input-263-bdf77303f0d5>:2: UserWarning:

`distplot` is a deprecated function and will be removed in seaborn v0.14.0.

Please adapt your code to use either `displot` (a figure-level function with
similar flexibility) or `histplot` (an axes-level function for histograms).

For a guide to updating your code to use the new functions, please see
https://gist.github.com/mwaskom/de44147ed2974457ad6372750bbe5751

  sns.distplot(df["compressionratio"], kde=True, color="orange", bins=10)
```

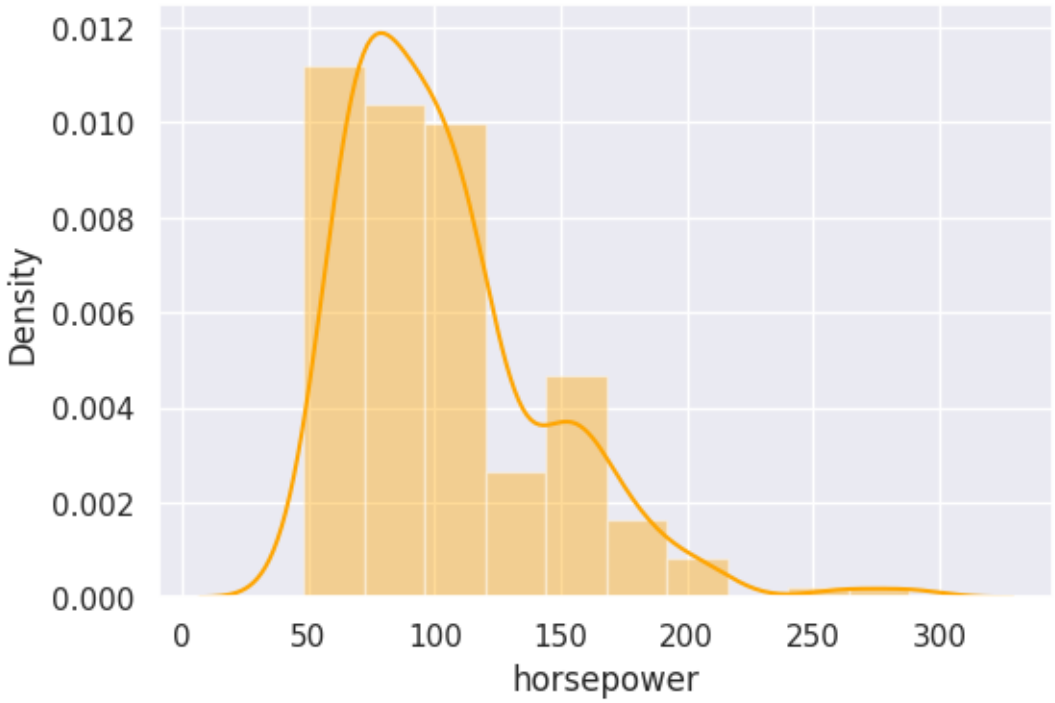
[ ]: <Axes: xlabel='compressionratio', ylabel='Density'>



[ ]:
```
sns.set(rc={"figure.figsize":(6,4)})
sns.distplot(df["horsepower"], kde=True, color="orange", bins=10)
```

```
<ipython-input-264-929ca17da2b3>:2: UserWarning:

`distplot` is a deprecated function and will be removed in seaborn v0.14.0.

Please adapt your code to use either `displot` (a figure-level function with
similar flexibility) or `histplot` (an axes-level function for histograms).

For a guide to updating your code to use the new functions, please see
https://gist.github.com/mwaskom/de44147ed2974457ad6372750bbe5751

  sns.distplot(df["horsepower"], kde=True, color="orange", bins=10)
```

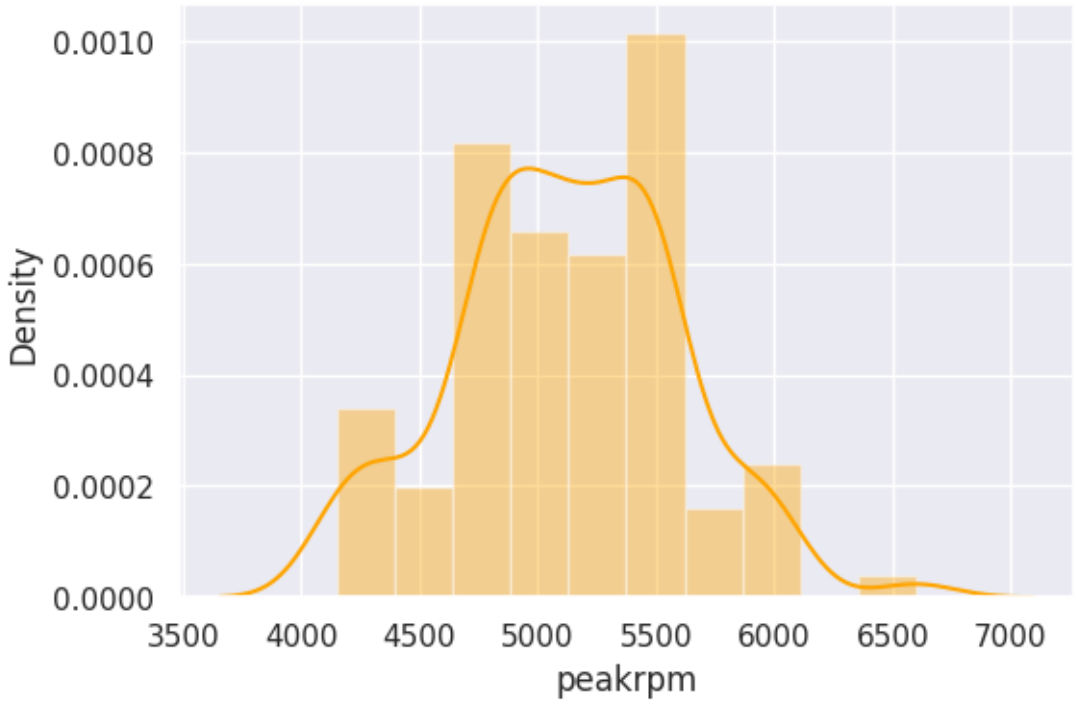
[ ]:
```
<Axes: xlabel='horsepower', ylabel='Density'>
```



[ ]:
```
sns.set(rc={"figure.figsize":(6,4)})
sns.distplot(df["peakrpm"], kde=True, color="orange", bins=10)
```

```
<ipython-input-265-5b6674878ec6>:2: UserWarning:

`distplot` is a deprecated function and will be removed in seaborn v0.14.0.

Please adapt your code to use either `displot` (a figure-level function with
similar flexibility) or `histplot` (an axes-level function for histograms).

For a guide to updating your code to use the new functions, please see
https://gist.github.com/mwaskom/de44147ed2974457ad6372750bbe5751

  sns.distplot(df["peakrpm"], kde=True, color="orange", bins=10)
```

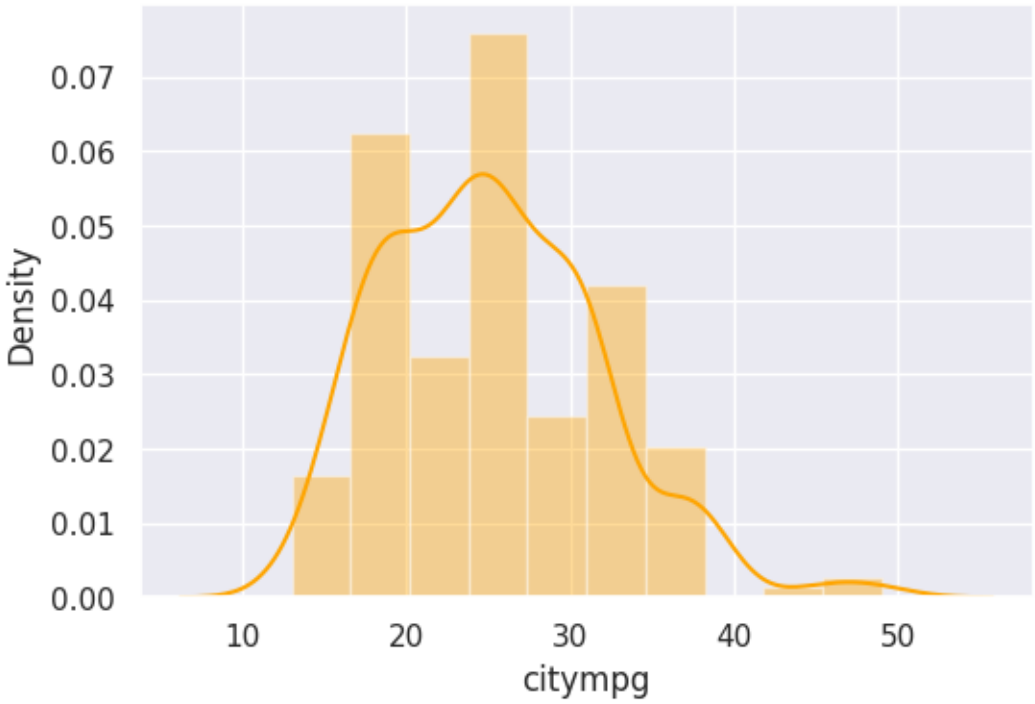
[ ]:
```
<Axes: xlabel='peakrpm', ylabel='Density'>
```



[ ]:
```
sns.set(rc={"figure.figsize":(6,4)})
sns.distplot(df["citympg"], kde=True, color="orange", bins=10)
```

```
<ipython-input-266-313140d11e4a>:2: UserWarning:

`distplot` is a deprecated function and will be removed in seaborn v0.14.0.

Please adapt your code to use either `displot` (a figure-level function with
similar flexibility) or `histplot` (an axes-level function for histograms).

For a guide to updating your code to use the new functions, please see
https://gist.github.com/mwaskom/de44147ed2974457ad6372750bbe5751

  sns.distplot(df["citympg"], kde=True, color="orange", bins=10)
```

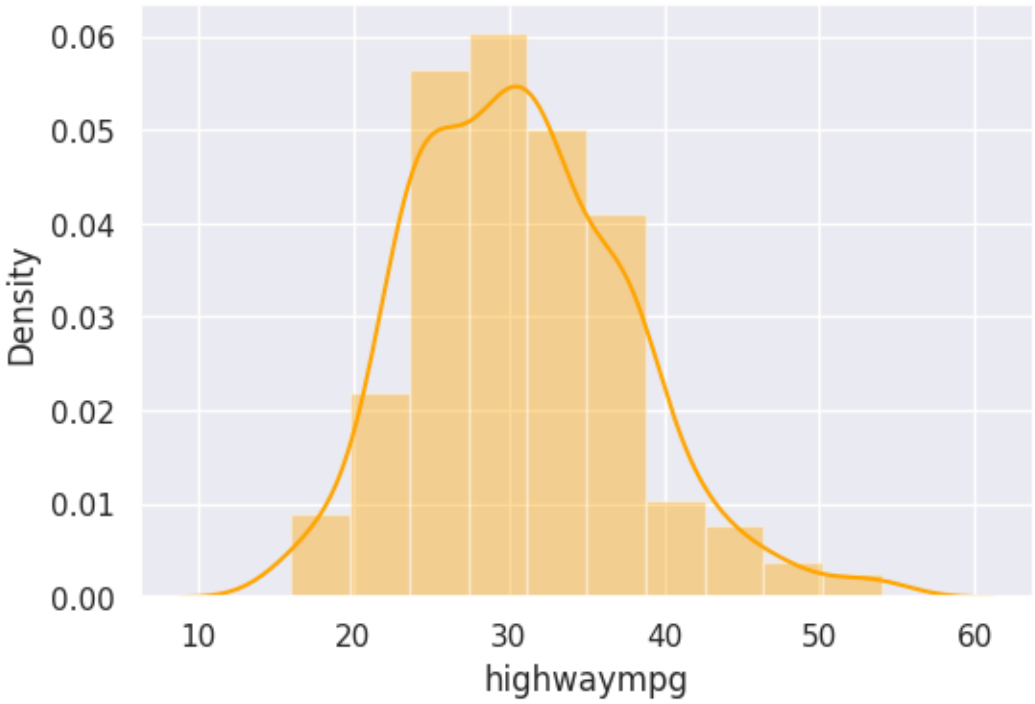
[ ]:
```
<Axes: xlabel='citympg', ylabel='Density'>
```



[ ]:
```
sns.set(rc={"figure.figsize":(6,4)})
sns.distplot(df["highwaympg"], kde=True, color="orange", bins=10)
```

```
<ipython-input-267-060fe6ea79fe>:2: UserWarning:

`distplot` is a deprecated function and will be removed in seaborn v0.14.0.

Please adapt your code to use either `displot` (a figure-level function with
similar flexibility) or `histplot` (an axes-level function for histograms).

For a guide to updating your code to use the new functions, please see
https://gist.github.com/mwaskom/de44147ed2974457ad6372750bbe5751

  sns.distplot(df["highwaympg"], kde=True, color="orange", bins=10)
```

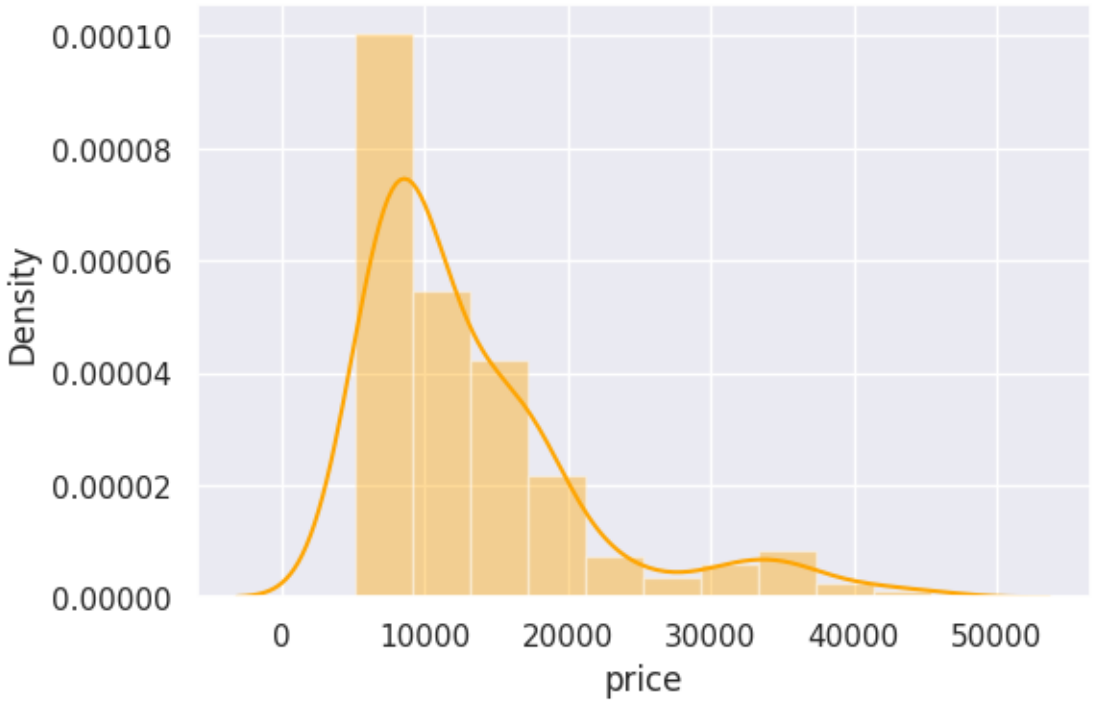
[ ]:
```
<Axes: xlabel='highwaympg', ylabel='Density'>
```



[ ]:
```
sns.set(rc={"figure.figsize":(6,4)})
sns.distplot(df["price"], kde=True, color="orange", bins=10)
```

```
<ipython-input-268-24d7eb5af33d>:2: UserWarning:

`distplot` is a deprecated function and will be removed in seaborn v0.14.0.

Please adapt your code to use either `displot` (a figure-level function with
similar flexibility) or `histplot` (an axes-level function for histograms).

For a guide to updating your code to use the new functions, please see
https://gist.github.com/mwaskom/de44147ed2974457ad6372750bbe5751

  sns.distplot(df["price"], kde=True, color="orange", bins=10)
```

[ ]:
```
<Axes: xlabel='price', ylabel='Density'>
```



5 EDA (Exploratory Data Analysis)

Remove Duplicate

[ ]:
```
df.duplicated().sum()
```

[ ]:
```
0
```

Check And Remove NaN Values

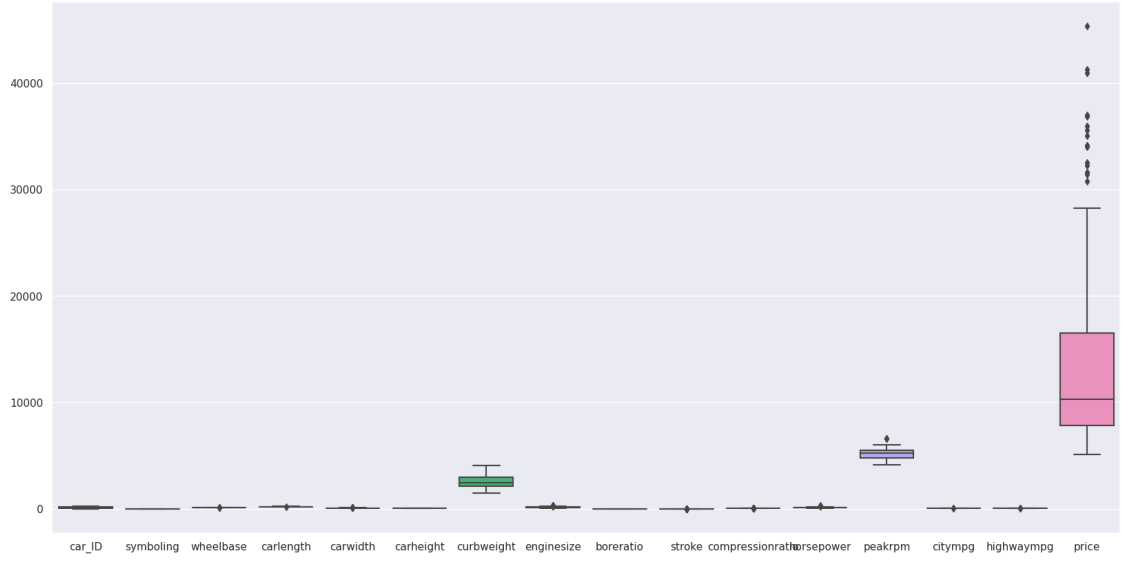
[ ]:
```
df.isnull().sum()
```

[ ]:
```
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
```

Removing Outlier

[ ]:
```
#Check Outliers
num_cols = df.select_dtypes(include=['int64', 'float64'])
plt.figure(figsize=(20,10))
#num_cols.boxplot()
sns.boxplot(data=num_cols)
plt.show()
```

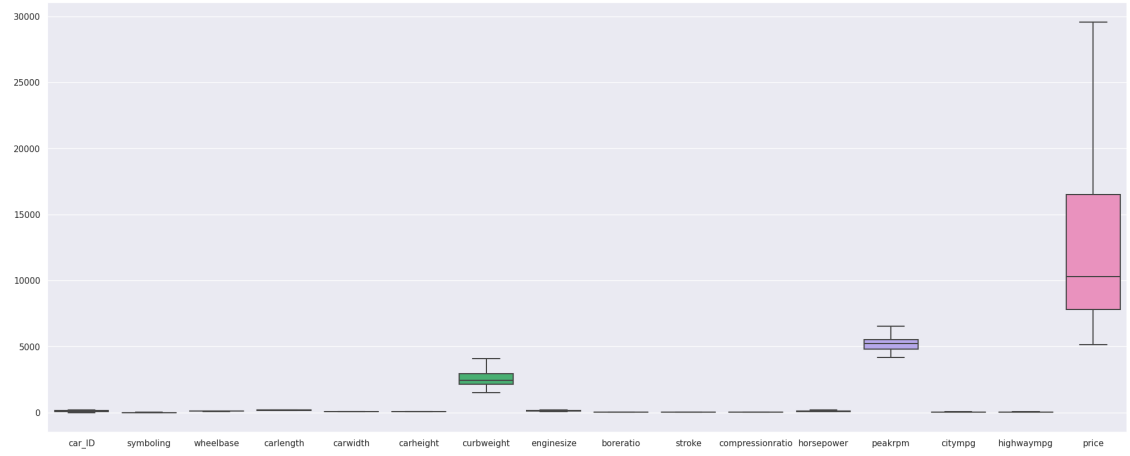


[ ]:
```
def remove_outlier(col):
  sorted(col)
  Q1,Q3 = col.quantile([0.25,0.75])
```

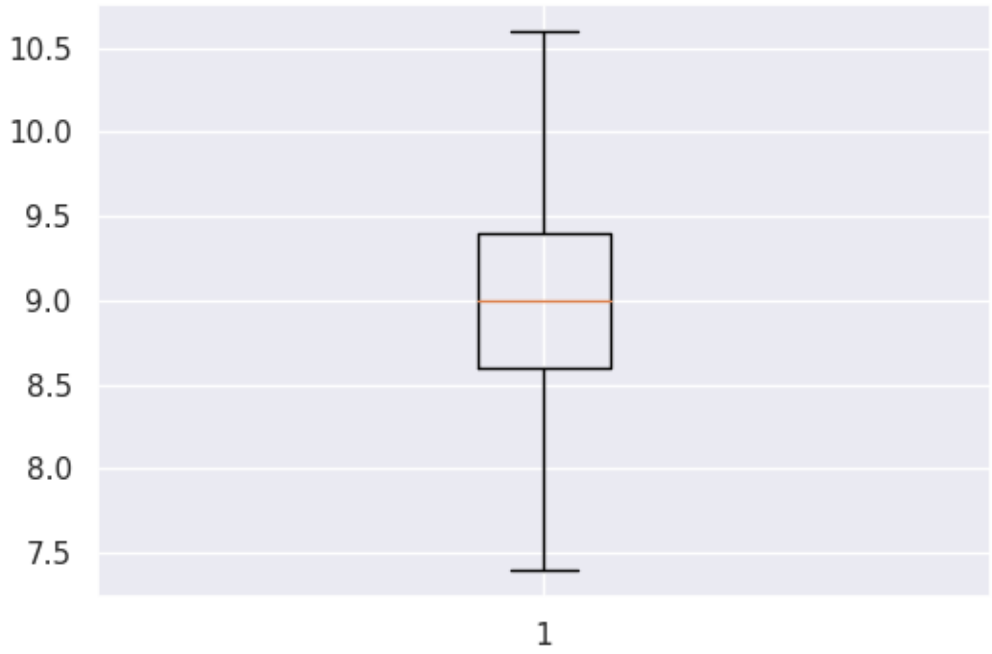
```
  IQR = Q3 - Q1
  lower_range = Q1 - (1.5 * IQR)
  upper_range = Q3 + (1.5 * IQR)
  return lower_range,upper_range
```

[ ]:
```
for i in num_cols.columns:
    lower_range,upper_range = remove_outlier(df[i])
    df[i] = np.where(df[i] > upper_range, upper_range, df[i])
    df[i] = np.where(df[i] < lower_range, lower_range, df[i])
```

[ ]:
```
#Check Outliers
num_cols = df.select_dtypes(include=['int64', 'float64'])
plt.figure(figsize=(25,10))
#num_cols.boxplot()
sns.boxplot(data=num_cols)
plt.show()
```



[ ]:
```
plt.boxplot(df["compressionratio"])
plt.show()
```



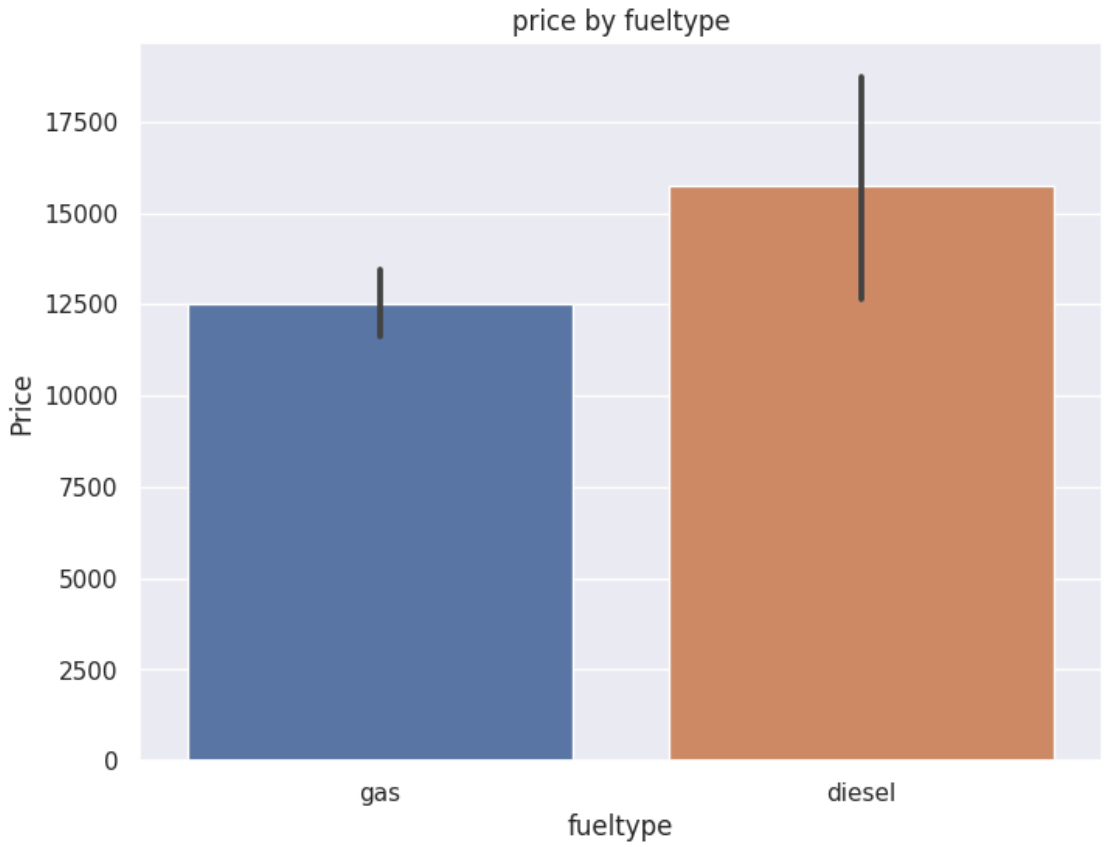
Bivaraite Analysis

[ ]:
```
df.info()
```

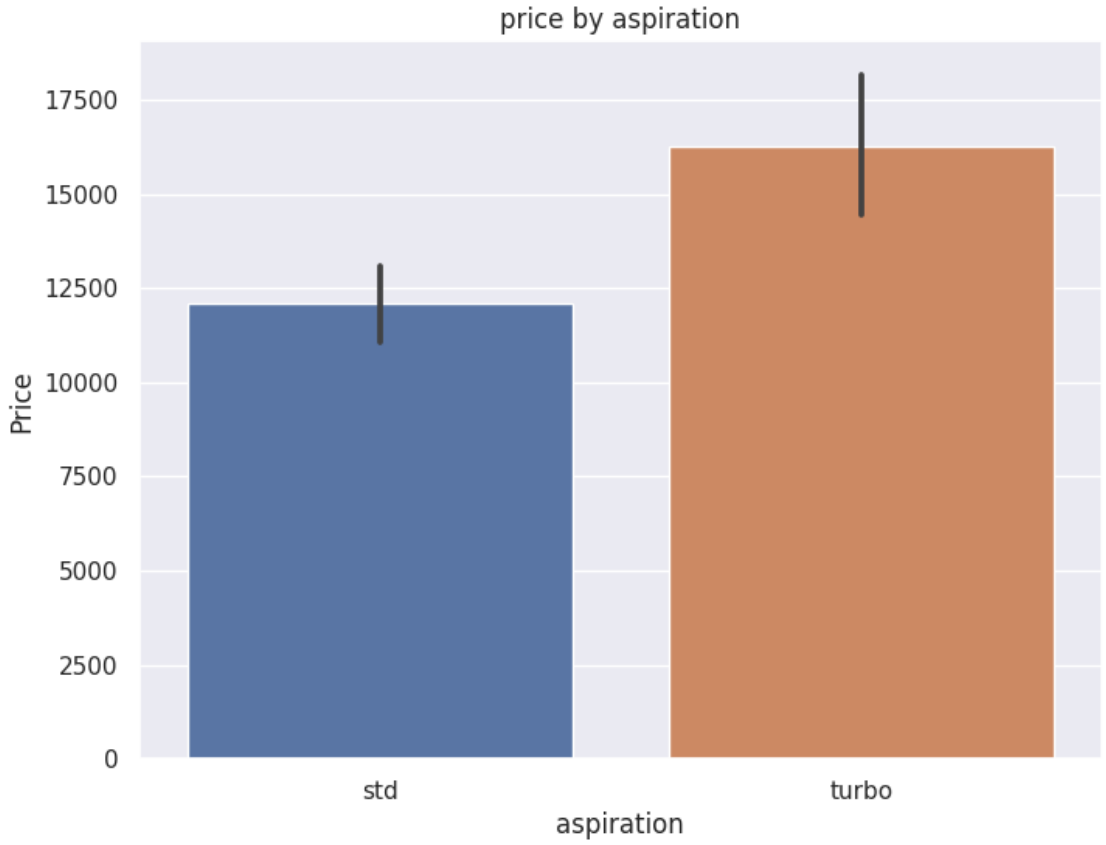
```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 205 entries, 0 to 204
Data columns (total 26 columns):
 #   Column            Non-Null Count  Dtype
---  ------            --------------  -----
 0   car_ID            205 non-null    float64
 1   symboling         205 non-null    float64
 2   CarName           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    float64
 14  enginetype        205 non-null    object
 15  cylindernumber    205 non-null    object
 16  enginesize        205 non-null    float64
```

```
 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    float64
 22  peakrpm           205 non-null    float64
 23  citympg           205 non-null    float64
 24  highwaympg        205 non-null    float64
 25  price             205 non-null    float64
dtypes: float64(16), object(10)
memory usage: 41.8+ KB
```

[ ]:
```
plt.figure(figsize=(8, 6))
sns.barplot(x='fueltype', y='price', data=df)
plt.title('price by fueltype')
plt.xlabel('fueltype')
plt.ylabel('Price')
plt.show()
```

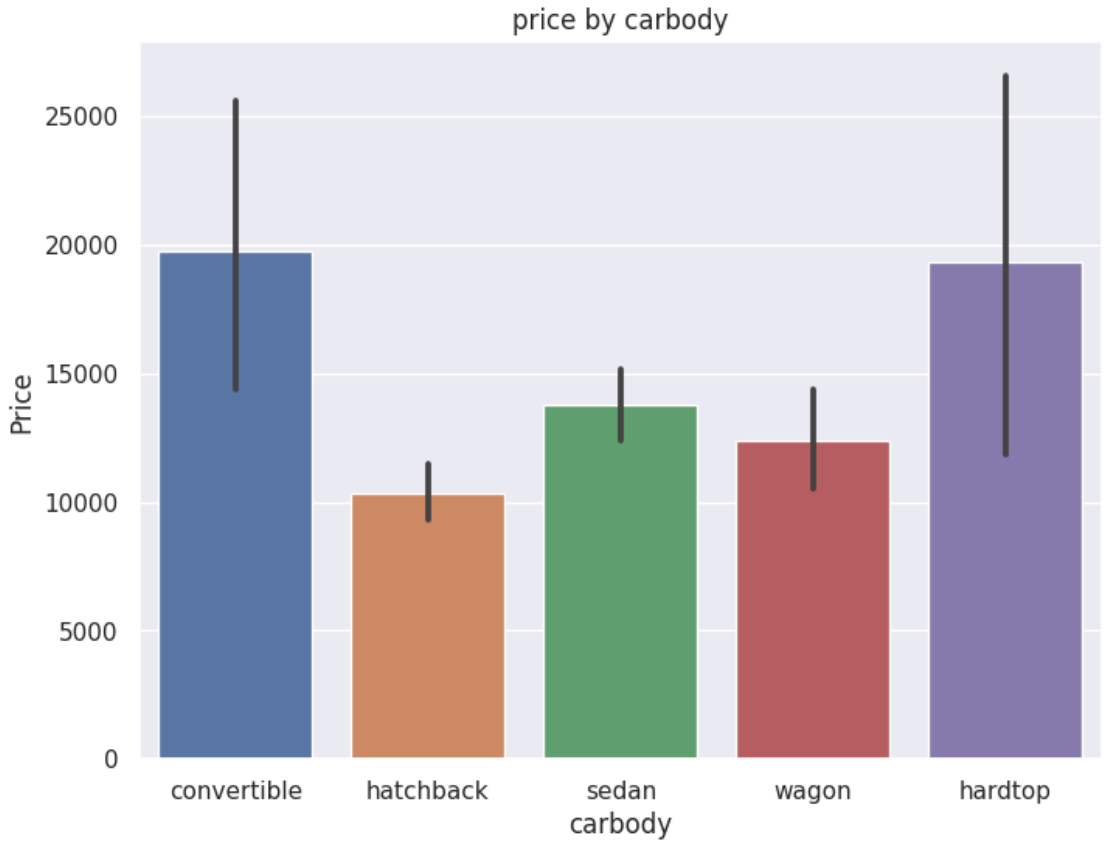


[ ]:
```
plt.figure(figsize=(8, 6))
sns.barplot(x='aspiration', y='price', data=df)
plt.title('price by aspiration')
plt.xlabel('aspiration')
plt.ylabel('Price')
plt.show()
```

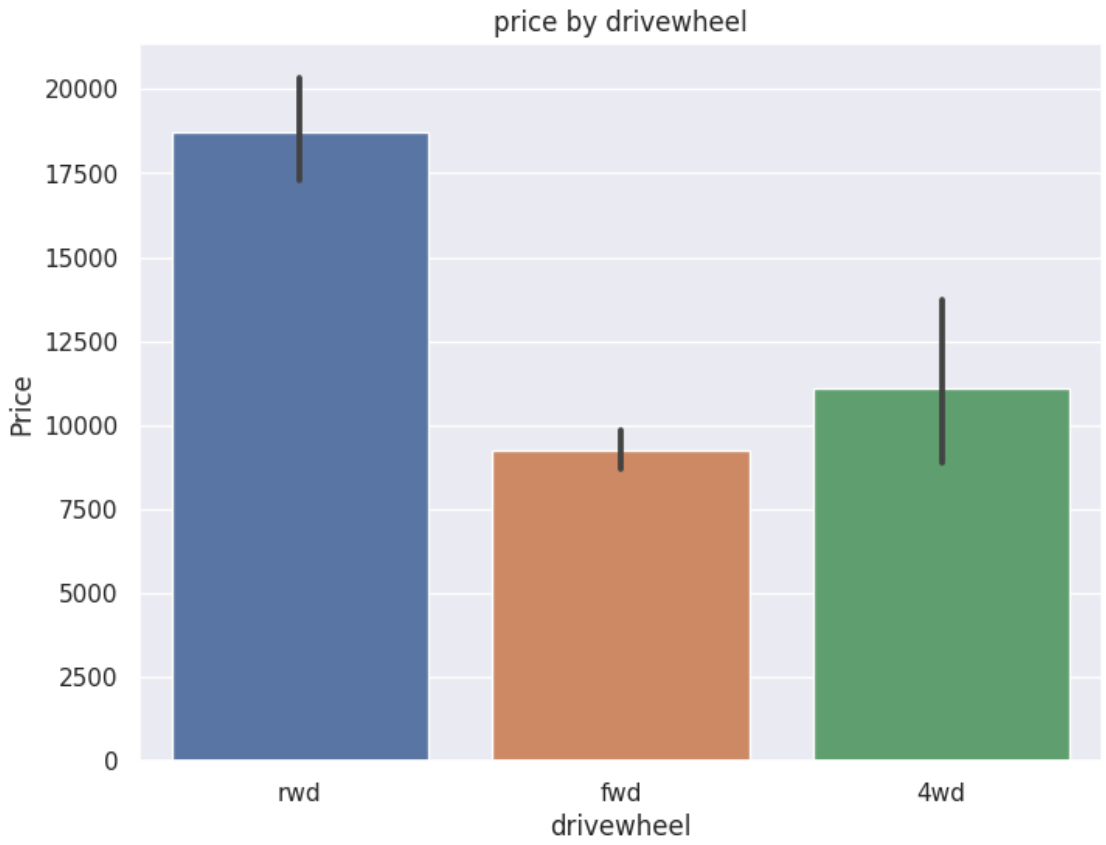


[ ]:
```
plt.figure(figsize=(8, 6))
sns.barplot(x='doornumber', y='price', data=df)
plt.title('price by doornumber')
plt.xlabel('doornumber')
plt.ylabel('Price')
plt.show()
```

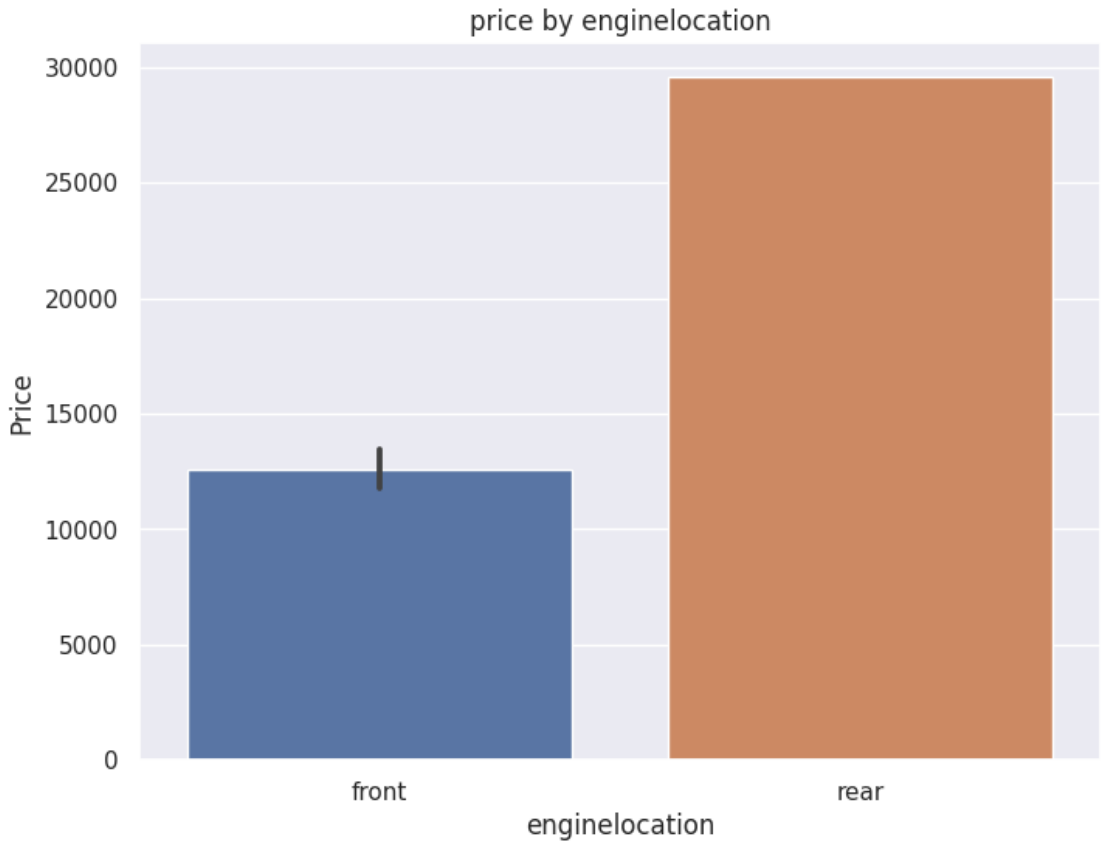
[ ]:
```
plt.figure(figsize=(8, 6))
sns.barplot(x='carbody', y='price', data=df)
plt.title('price by carbody')
plt.xlabel('carbody')
plt.ylabel('Price')
plt.show()
```



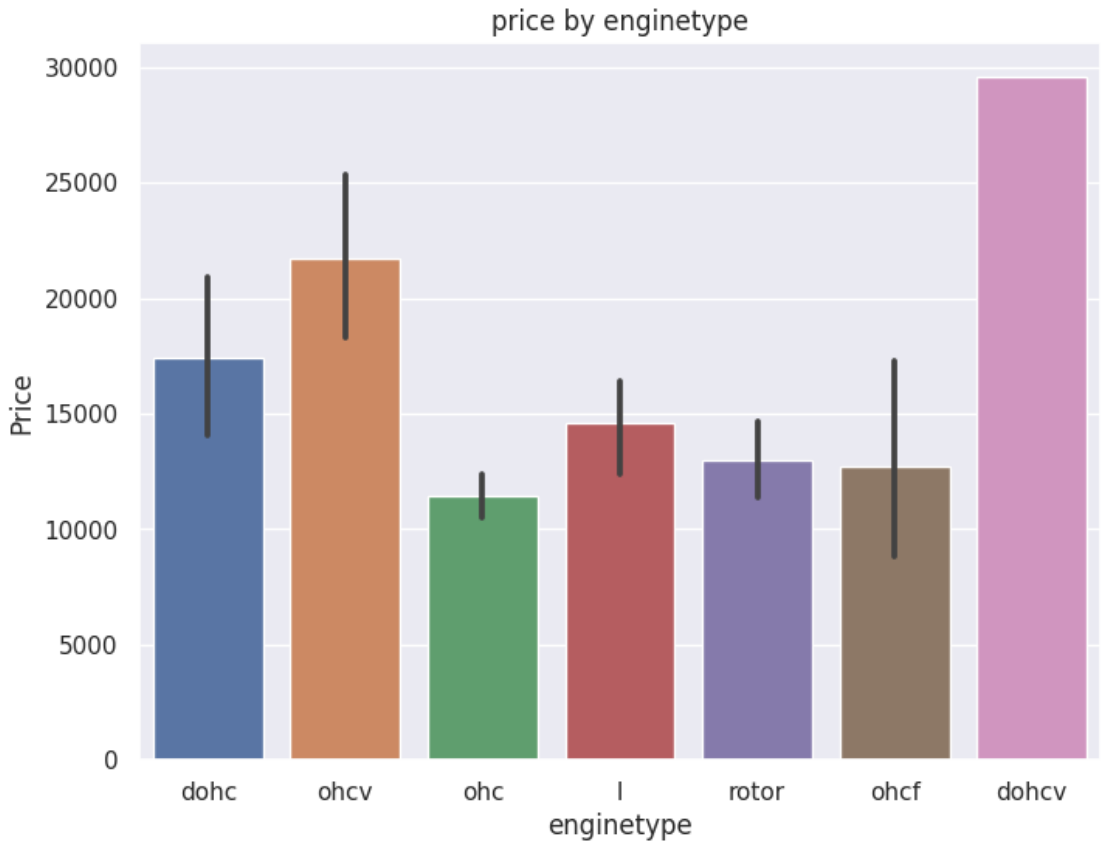
[ ]:
```
plt.figure(figsize=(8, 6))
sns.barplot(x='drivewheel', y='price', data=df)
plt.title('price by drivewheel')
plt.xlabel('drivewheel')
plt.ylabel('Price')
plt.show()
```



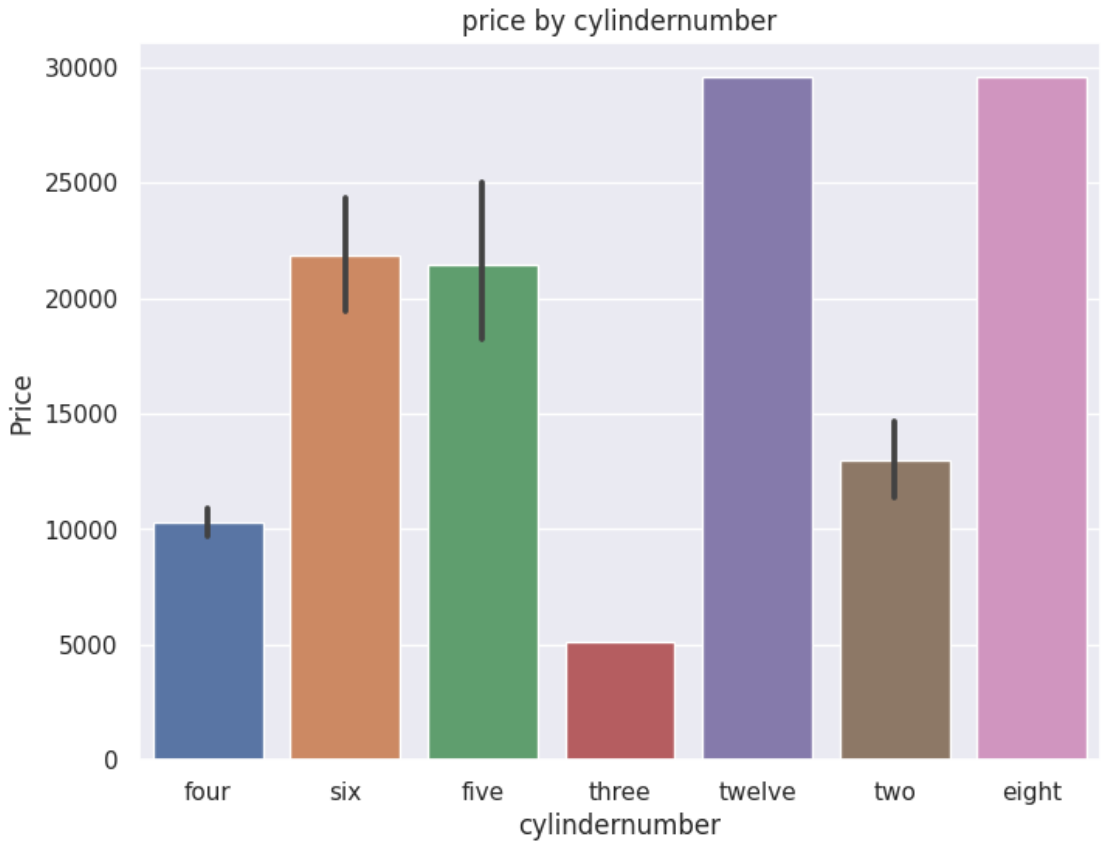
[ ]:
```
plt.figure(figsize=(8, 6))
sns.barplot(x='enginelocation', y='price', data=df)
plt.title('price by enginelocation')
plt.xlabel('enginelocation')
plt.ylabel('Price')
plt.show()
```



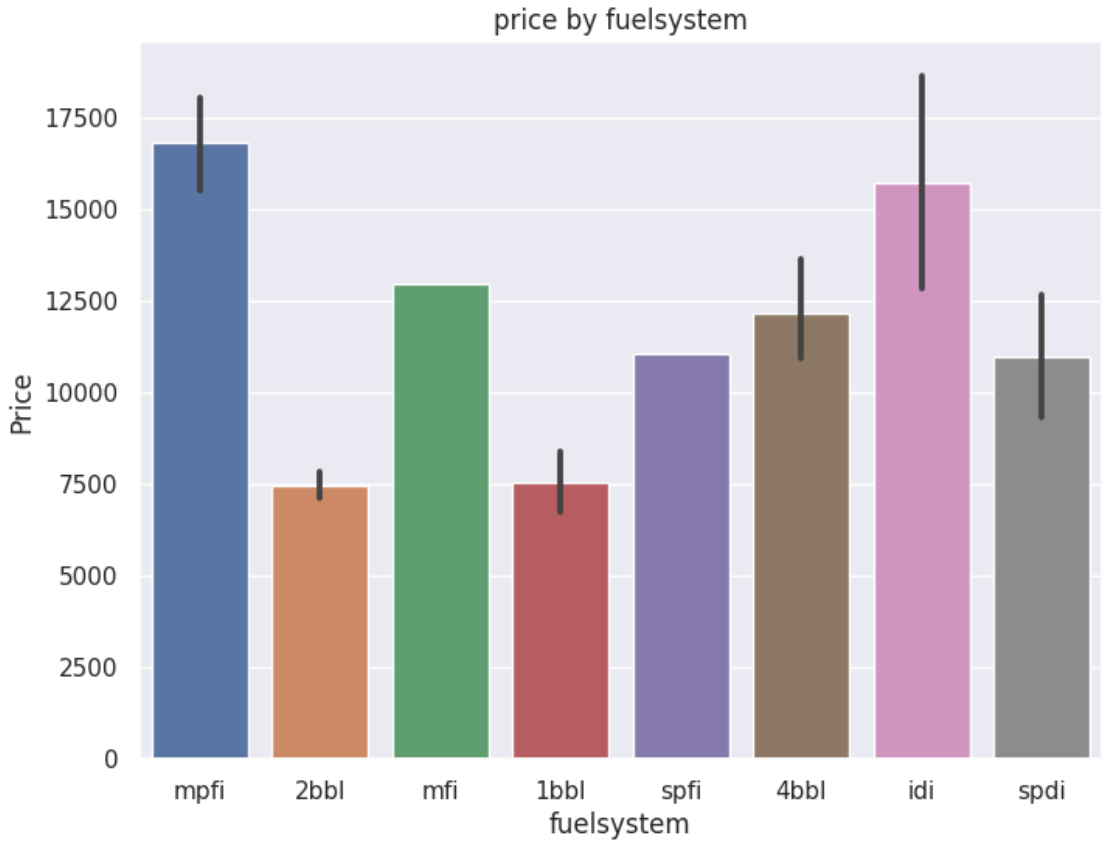
[ ]:
```
plt.figure(figsize=(8, 6))
sns.barplot(x='enginetype', y='price', data=df)
plt.title('price by enginetype')
plt.xlabel('enginetype')
plt.ylabel('Price')
plt.show()
```



[ ]:
```
plt.figure(figsize=(8, 6))
sns.barplot(x='cylindernumber', y='price', data=df)
plt.title('price by cylindernumber')
plt.xlabel('cylindernumber')
plt.ylabel('Price')
plt.show()
```

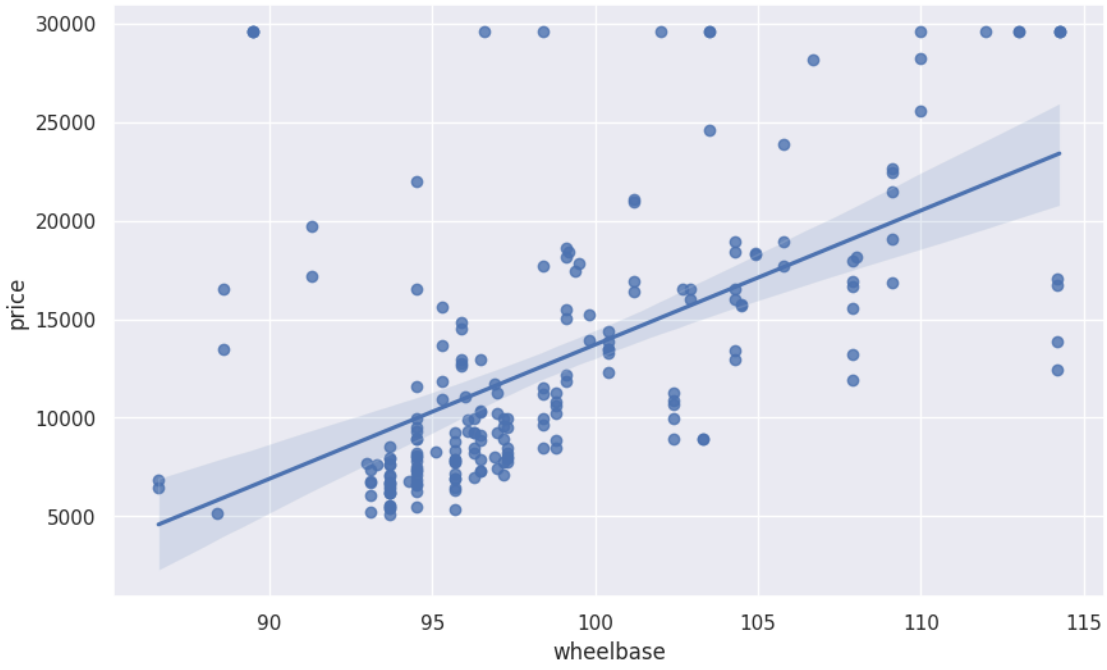


[ ]:
```
plt.figure(figsize=(8, 6))
sns.barplot(x='fuelsystem', y='price', data=df)
plt.title('price by fuelsystem')
plt.xlabel('fuelsystem')
plt.ylabel('Price')
plt.show()
```

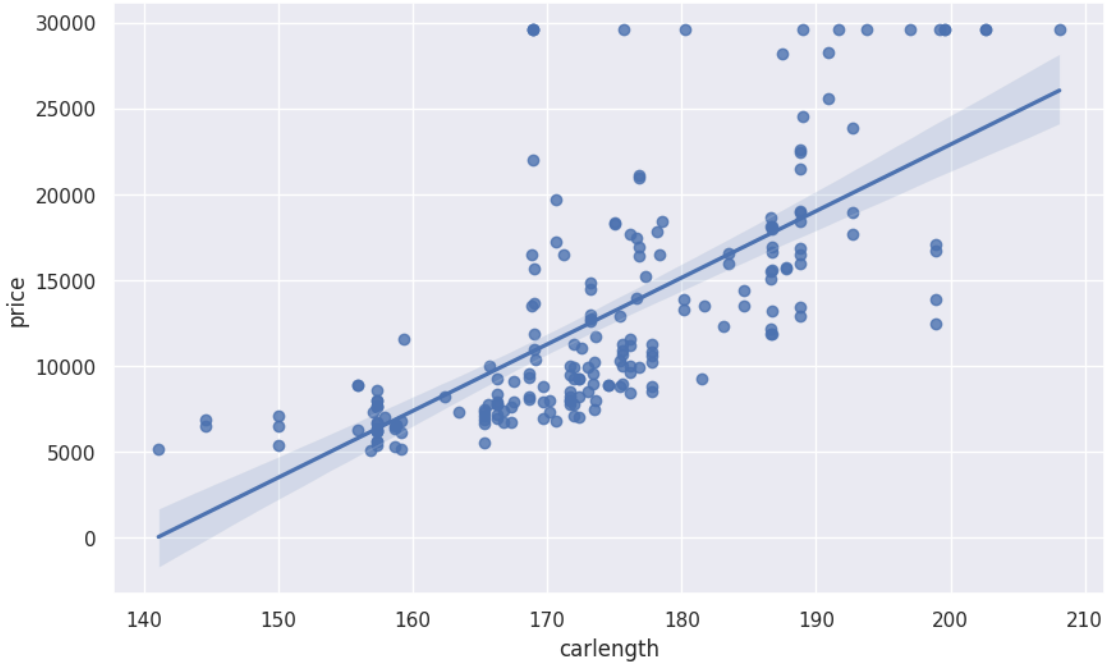


[ ]:

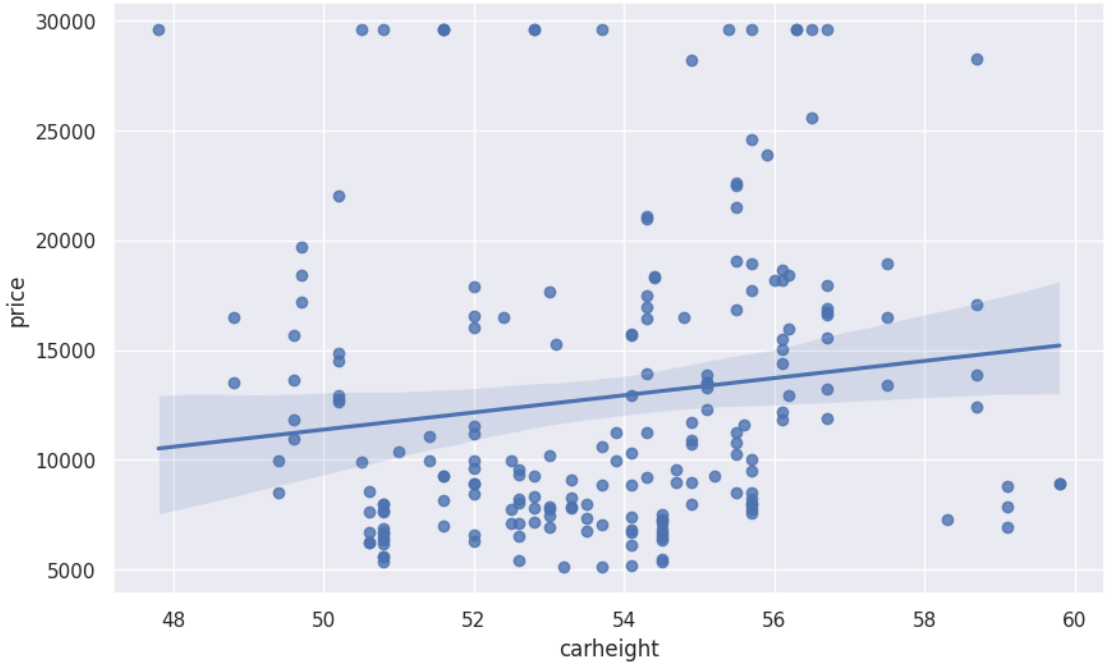
[ ]:
```
plt.figure(figsize=(10,6))
sns.regplot(x="wheelbase", y="price", data=df)
plt.show()
```



[ ]:
```
plt.figure(figsize=(10,6))
sns.regplot(x="carlength", y="price", data=df)
plt.show()
```

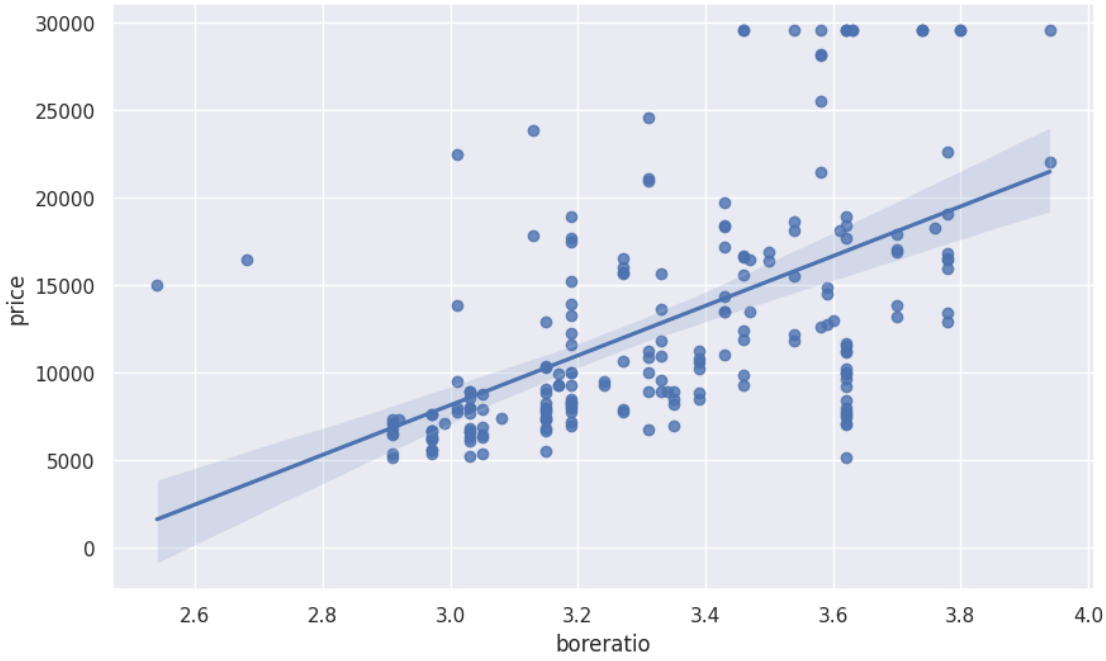


[ ]:
```
plt.figure(figsize=(10,6))
sns.regplot(x="carheight", y="price", data=df)
plt.show()
```

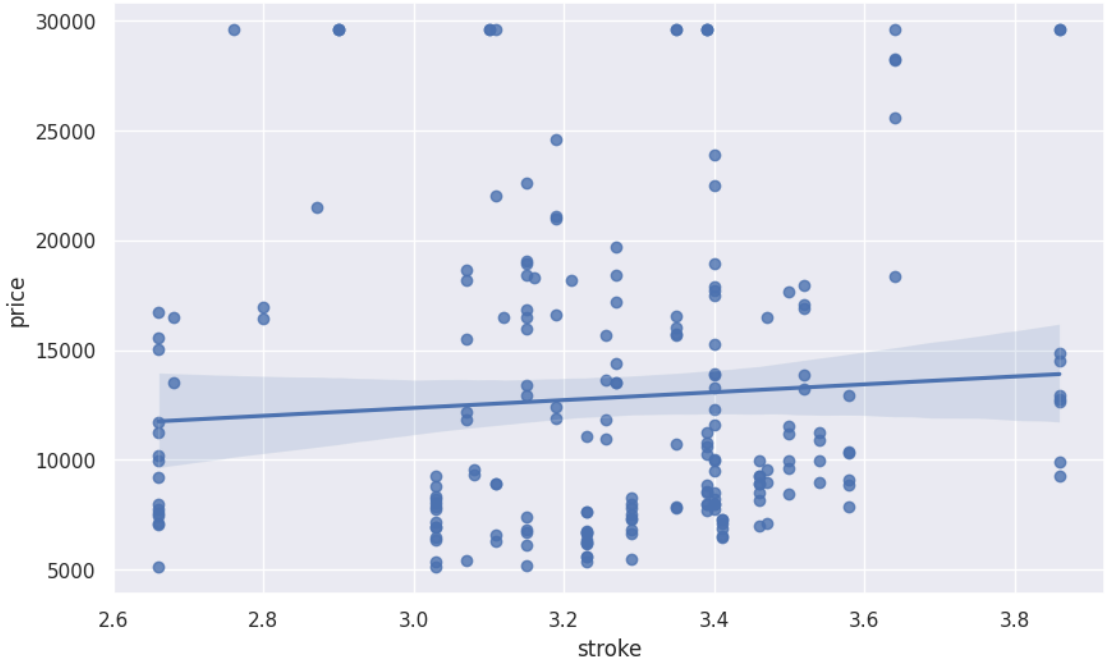


[ ]:
```
plt.figure(figsize=(10,6))
sns.regplot(x="curbweight", y="price", data=df)
plt.show()
```

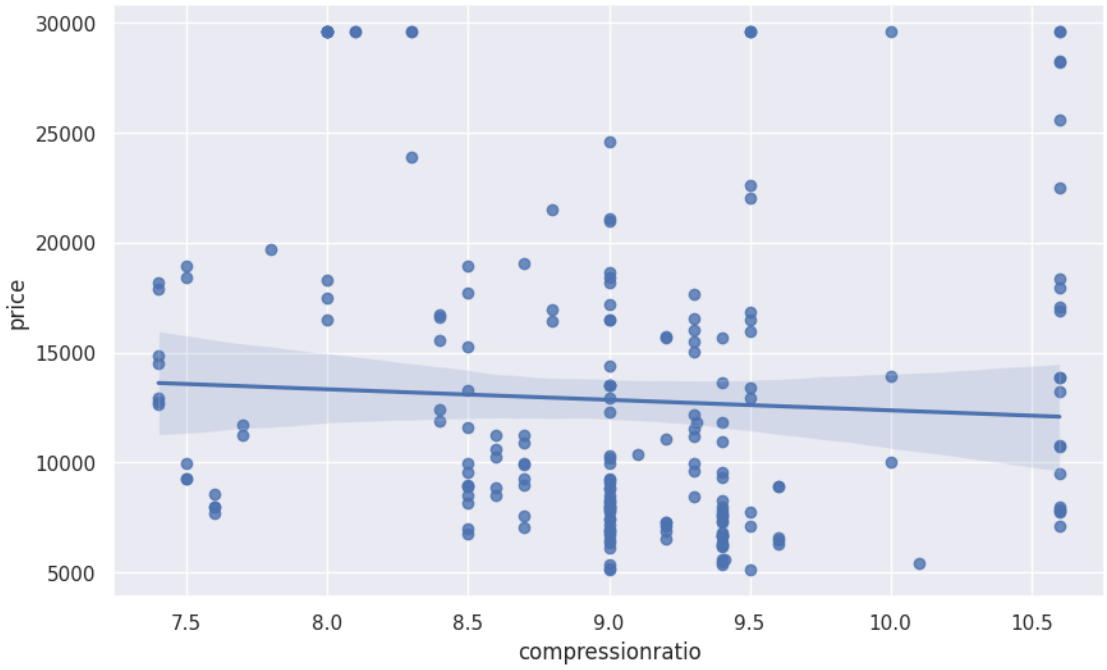
[ ]:
```
plt.figure(figsize=(10,6))
sns.regplot(x="boreratio", y="price", data=df)
plt.show()
```



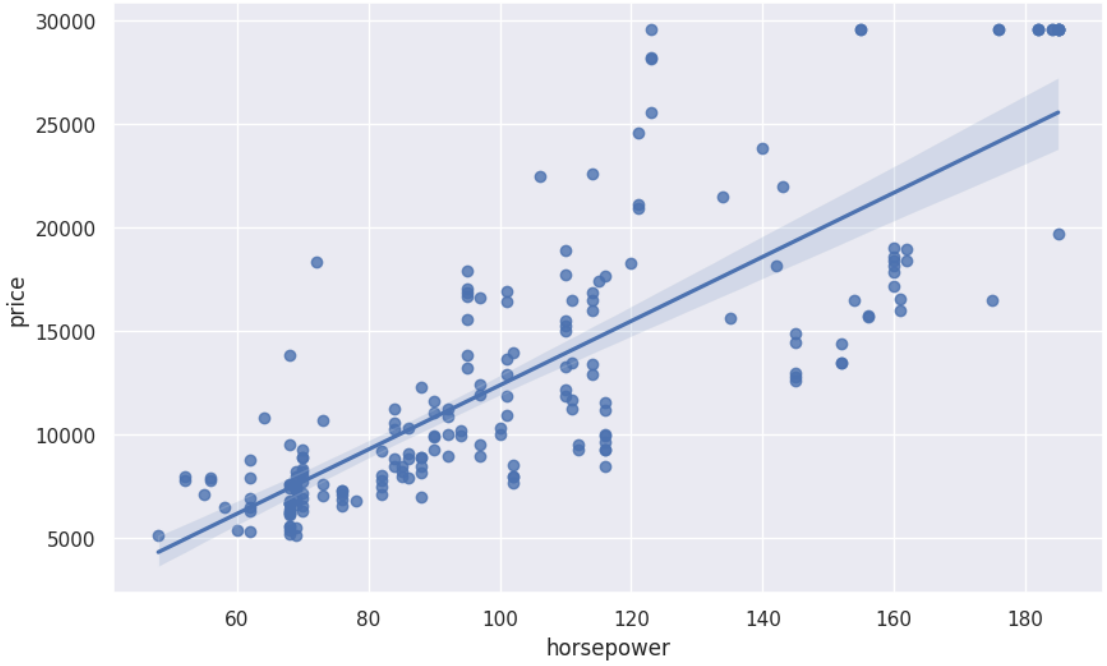
[ ]:
```
plt.figure(figsize=(10,6))
sns.regplot(x="stroke", y="price", data=df)
plt.show()
```



[ ]:
```
plt.figure(figsize=(10,6))
sns.regplot(x="compressionratio", y="price", data=df)
plt.show()
```

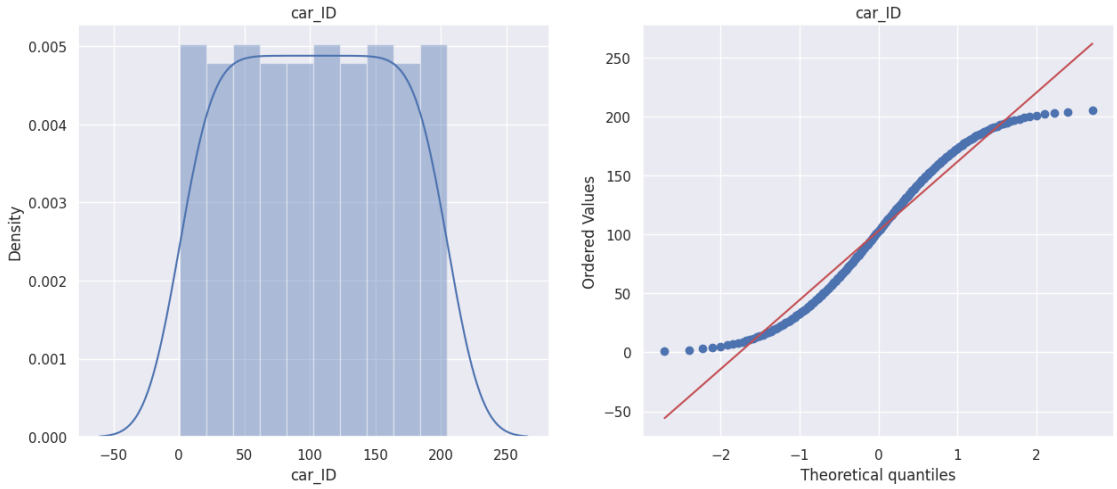


[ ]:
```
plt.figure(figsize=(10,6))
sns.regplot(x="horsepower", y="price", data=df)
plt.show()
```



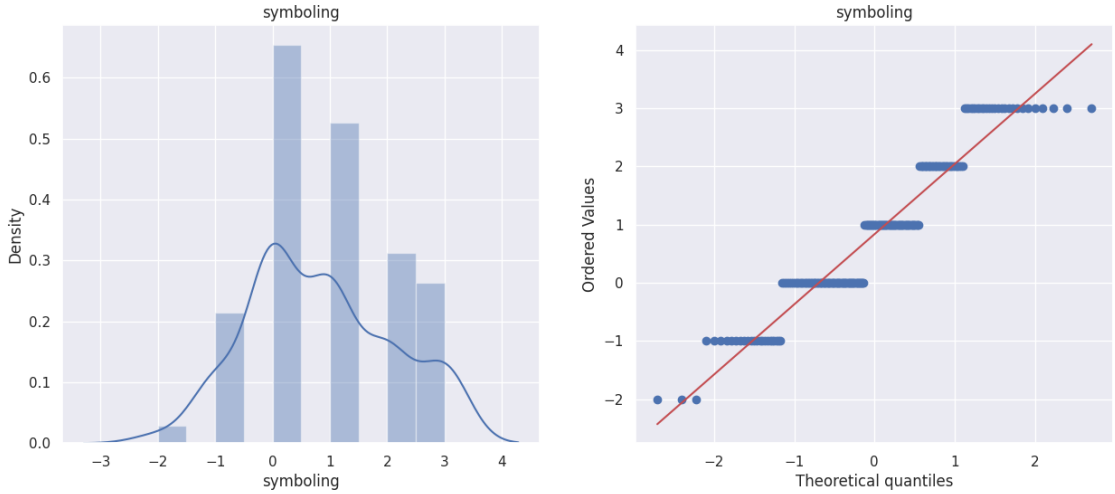
[ ]:
```
num_cols = df.select_dtypes(include=["int64","float64"])
def plots(num_cols, variable):
    plt.figure(figsize=(15,6))
    plt.subplot(1, 2, 1)
    #num_cols[variable].hist()
    sns.distplot(num_cols[variable], kde=True, bins=10)
    plt.title(variable)
    plt.subplot(1, 2, 2)
    stats.probplot(num_cols[variable], dist="norm", plot=pylab)
    plt.title(variable)
    plt.show()
for i in num_cols.columns:
  plots(num_cols, i)
```

```
<ipython-input-294-7af58d2ef5aa>:6: UserWarning:

`distplot` is a deprecated function and will be removed in seaborn v0.14.0.

Please adapt your code to use either `displot` (a figure-level function with
similar flexibility) or `histplot` (an axes-level function for histograms).

For a guide to updating your code to use the new functions, please see
https://gist.github.com/mwaskom/de44147ed2974457ad6372750bbe5751

  sns.distplot(num_cols[variable], kde=True, bins=10)
```

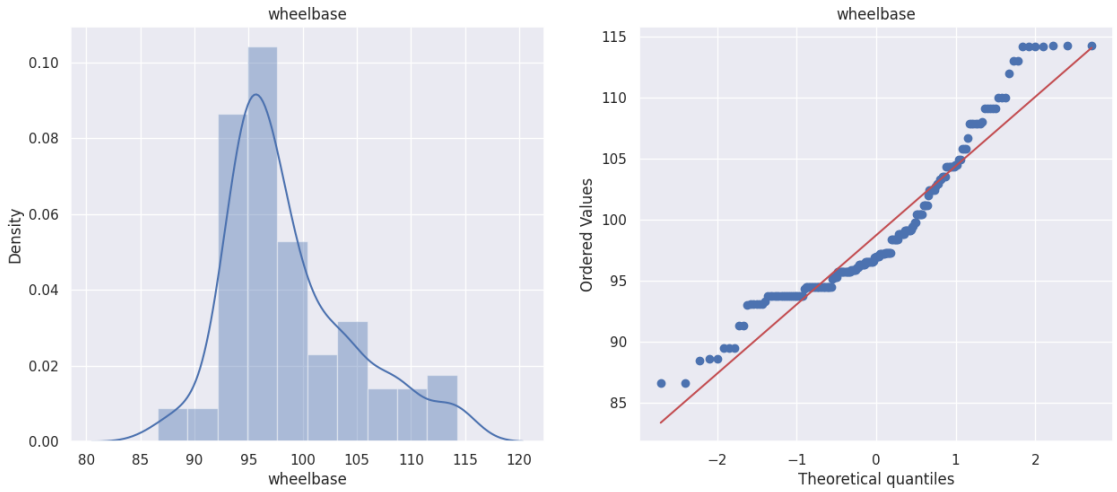



```
<ipython-input-294-7af58d2ef5aa>:6: UserWarning:

`distplot` is a deprecated function and will be removed in seaborn v0.14.0.

Please adapt your code to use either `displot` (a figure-level function with
```

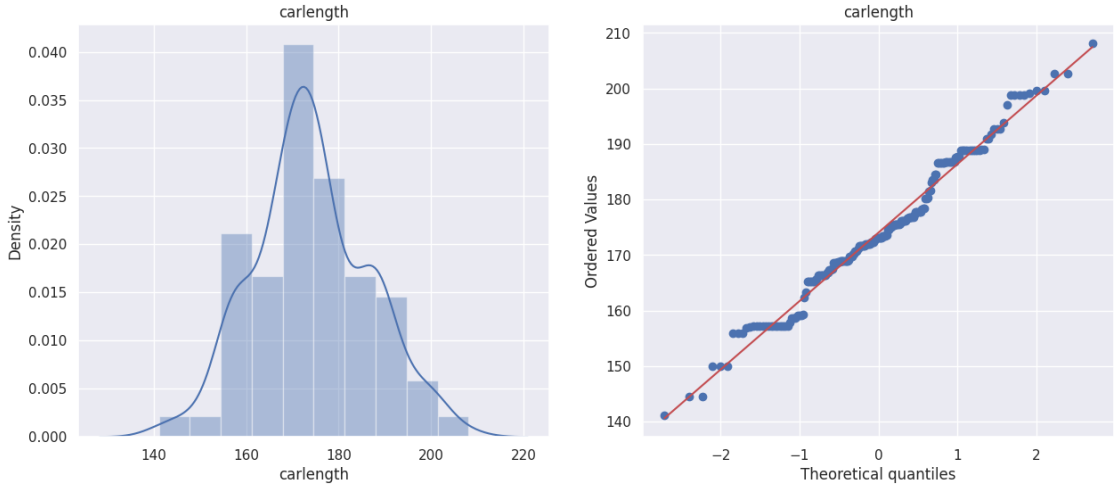
```
similar flexibility) or `histplot` (an axes-level function for histograms).

For a guide to updating your code to use the new functions, please see
https://gist.github.com/mwaskom/de44147ed2974457ad6372750bbe5751

  sns.distplot(num_cols[variable], kde=True, bins=10)
```




```
<ipython-input-294-7af58d2ef5aa>:6: UserWarning:

`distplot` is a deprecated function and will be removed in seaborn v0.14.0.

Please adapt your code to use either `displot` (a figure-level function with
similar flexibility) or `histplot` (an axes-level function for histograms).

For a guide to updating your code to use the new functions, please see
https://gist.github.com/mwaskom/de44147ed2974457ad6372750bbe5751

  sns.distplot(num_cols[variable], kde=True, bins=10)
```




```
<ipython-input-294-7af58d2ef5aa>:6: UserWarning:

`distplot` is a deprecated function and will be removed in seaborn v0.14.0.

Please adapt your code to use either `displot` (a figure-level function with
similar flexibility) or `histplot` (an axes-level function for histograms).

For a guide to updating your code to use the new functions, please see
https://gist.github.com/mwaskom/de44147ed2974457ad6372750bbe5751

  sns.distplot(num_cols[variable], kde=True, bins=10)
```




```
<ipython-input-294-7af58d2ef5aa>:6: UserWarning:
```

```
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```

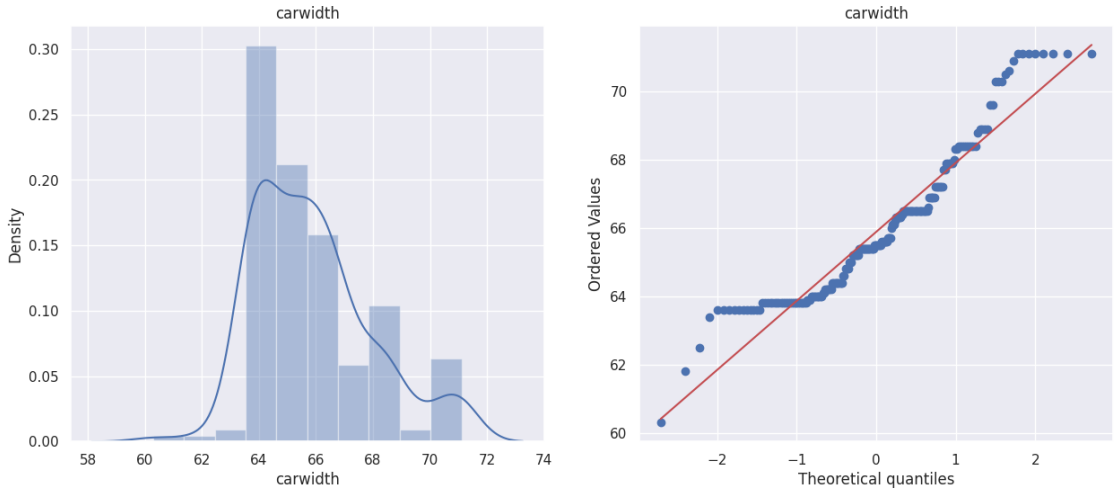


```
<ipython-input-294-7af58d2ef5aa>:6: UserWarning:

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```

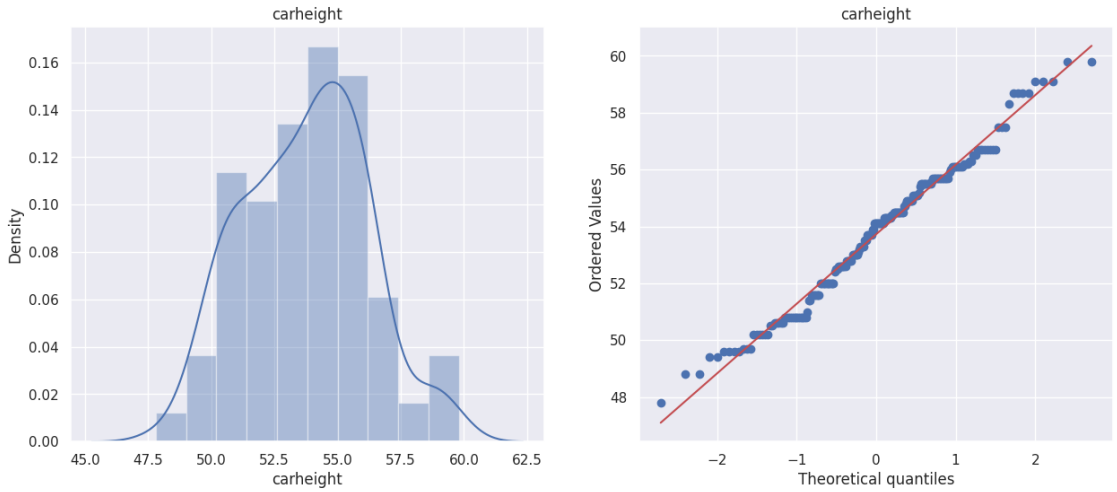


```
<ipython-input-294-7af58d2ef5aa>:6: UserWarning:

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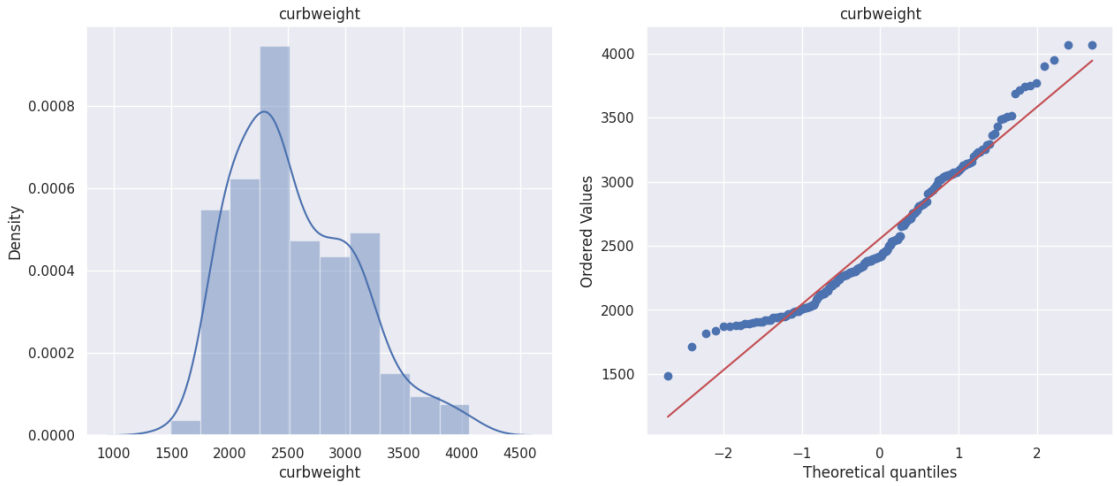


```
<ipython-input-294-7af58d2ef5aa>:6: UserWarning:
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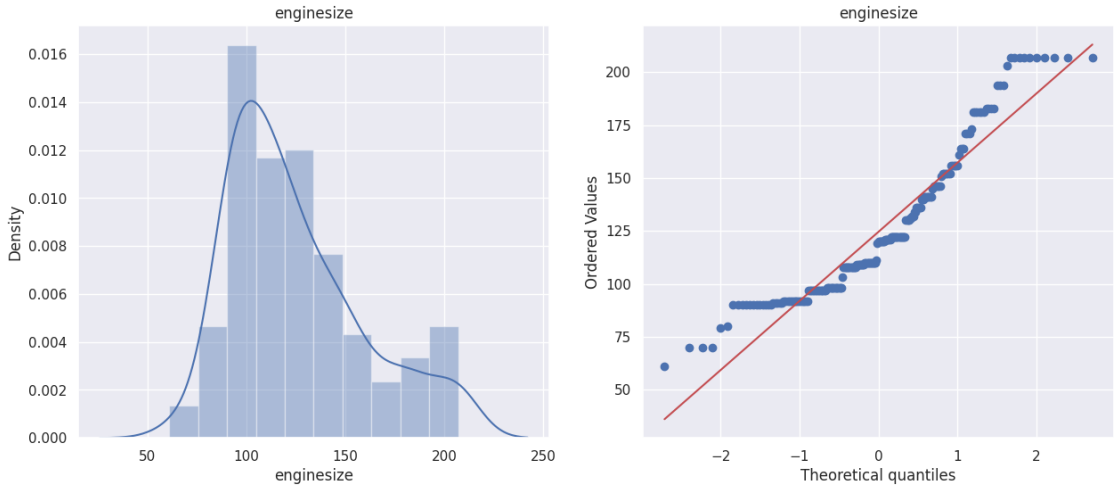


```
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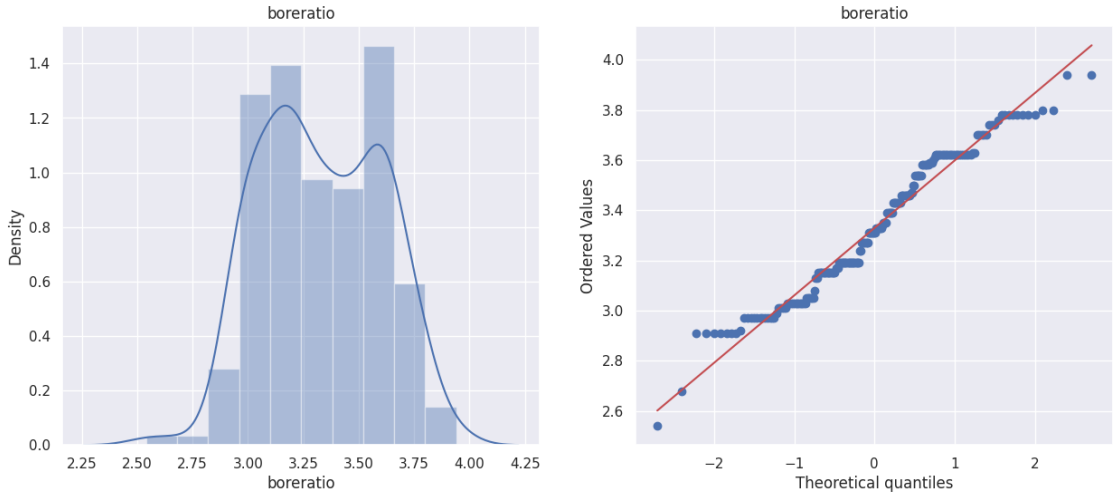


```
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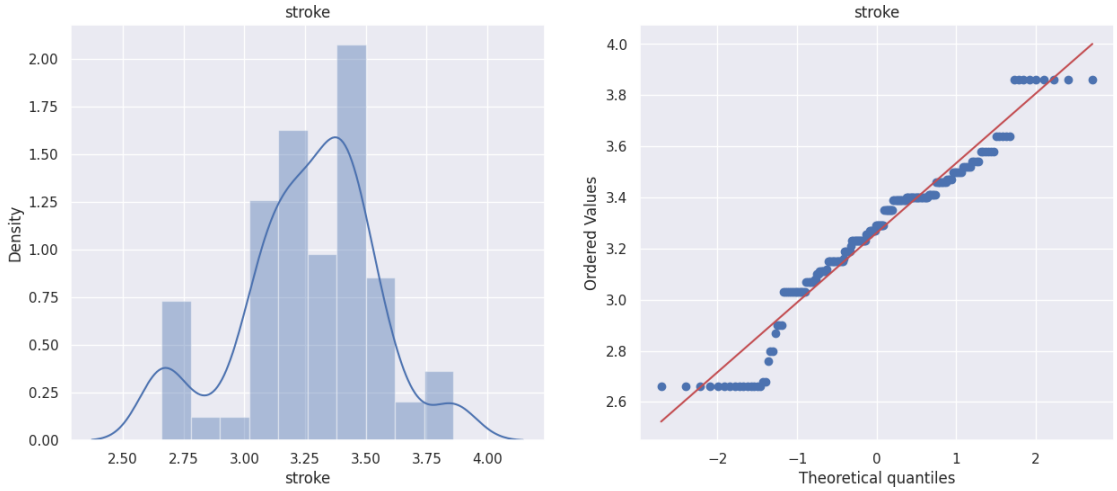
```




```
<ipython-input-294-7af58d2ef5aa>:6: UserWarning:
```

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```

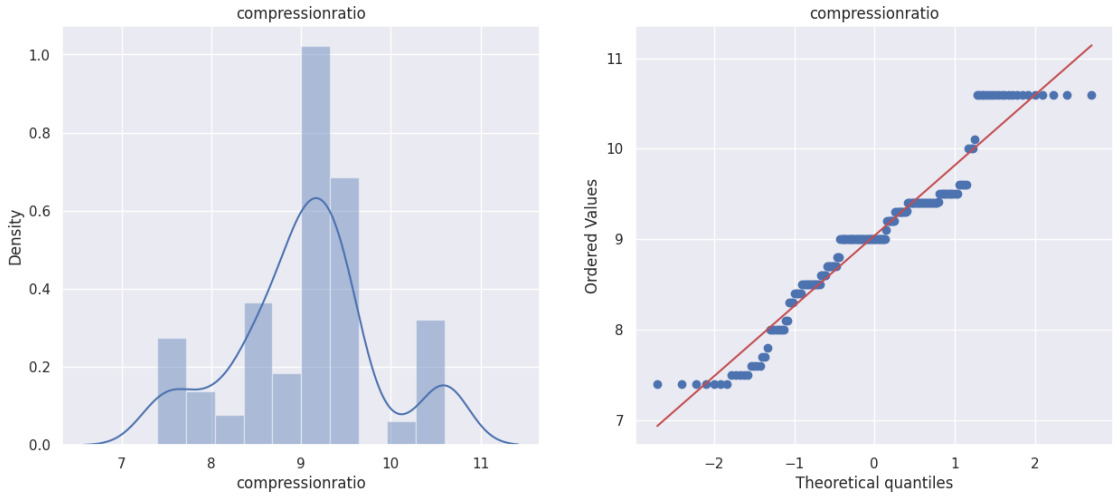


```
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```

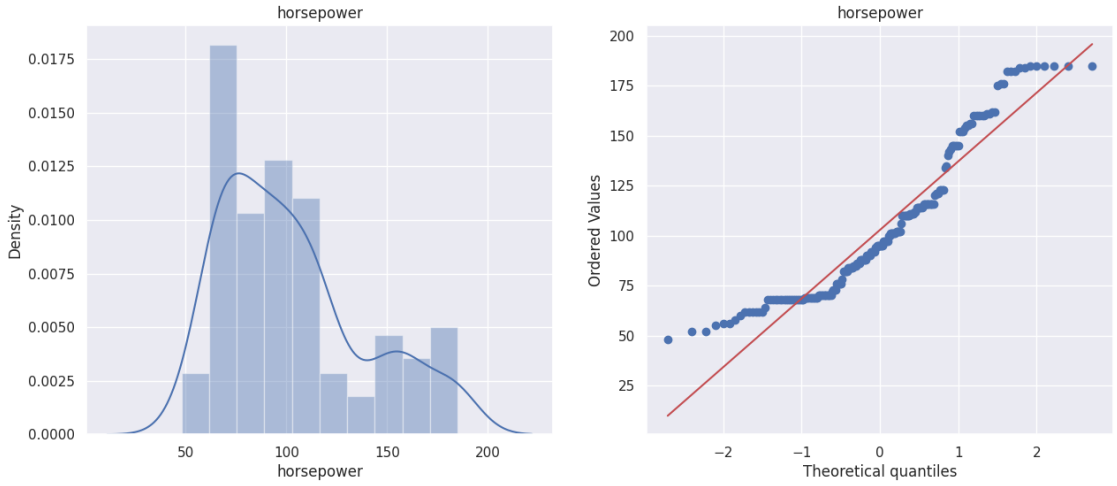


```
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```

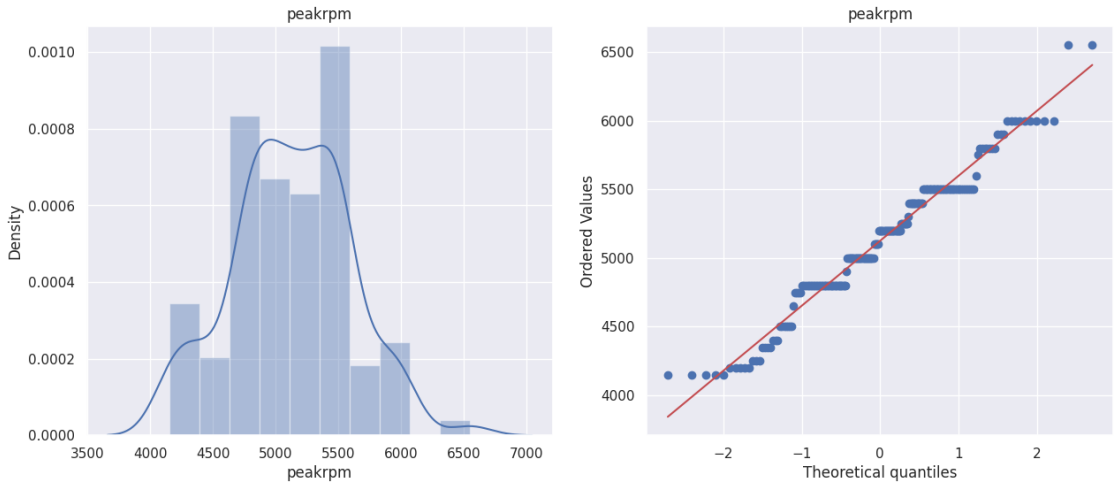


```
<ipython-input-294-7af58d2ef5aa>:6: UserWarning:
```

```
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```

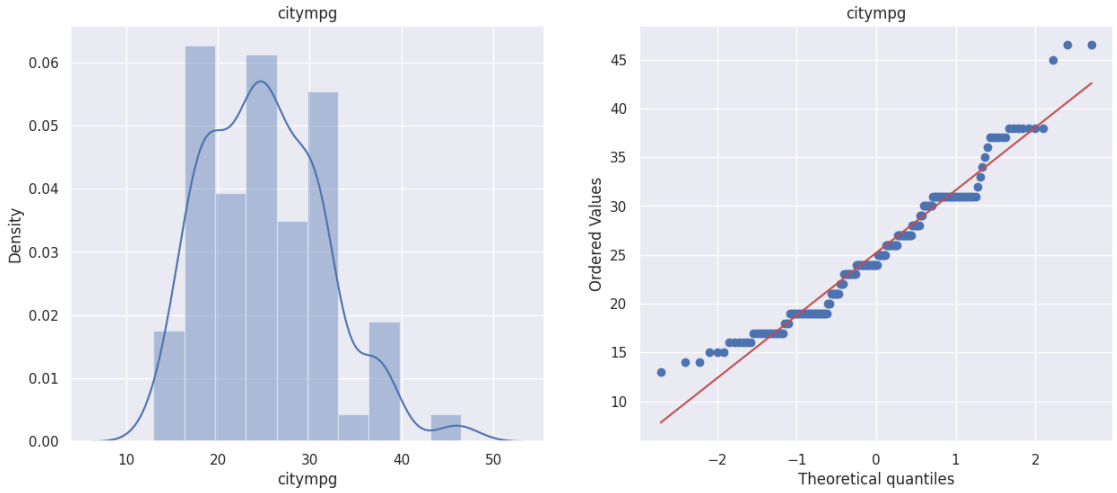


```
<ipython-input-294-7af58d2ef5aa>:6: UserWarning:

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  sns.distplot(num_cols[variable], kde=True, bins=10)
```

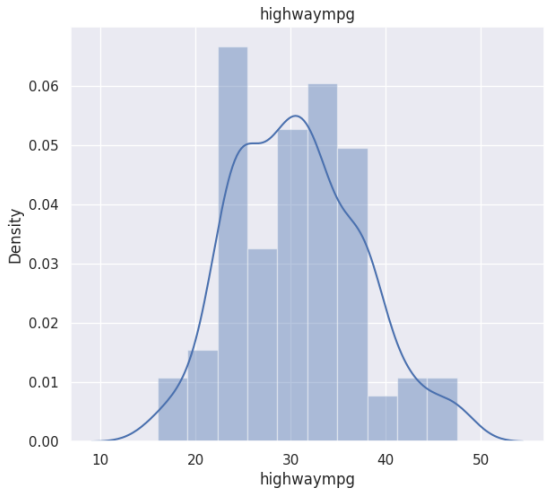

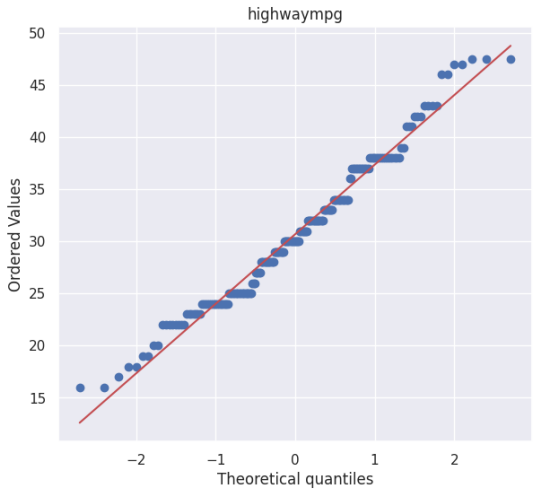


```
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  sns.distplot(num_cols[variable], kde=True, bins=10)
```
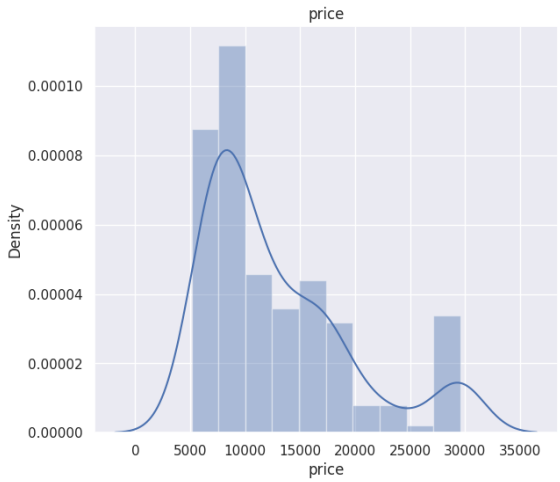
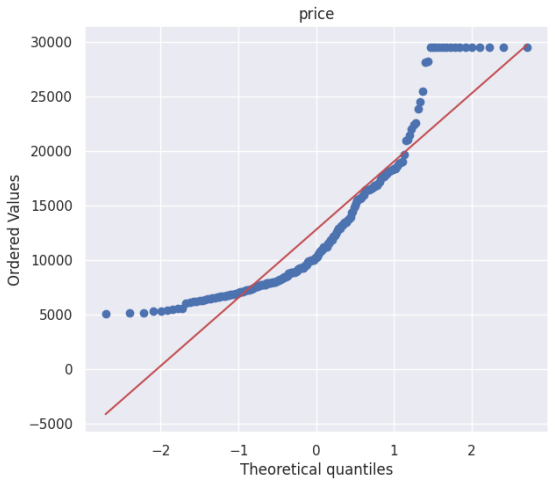
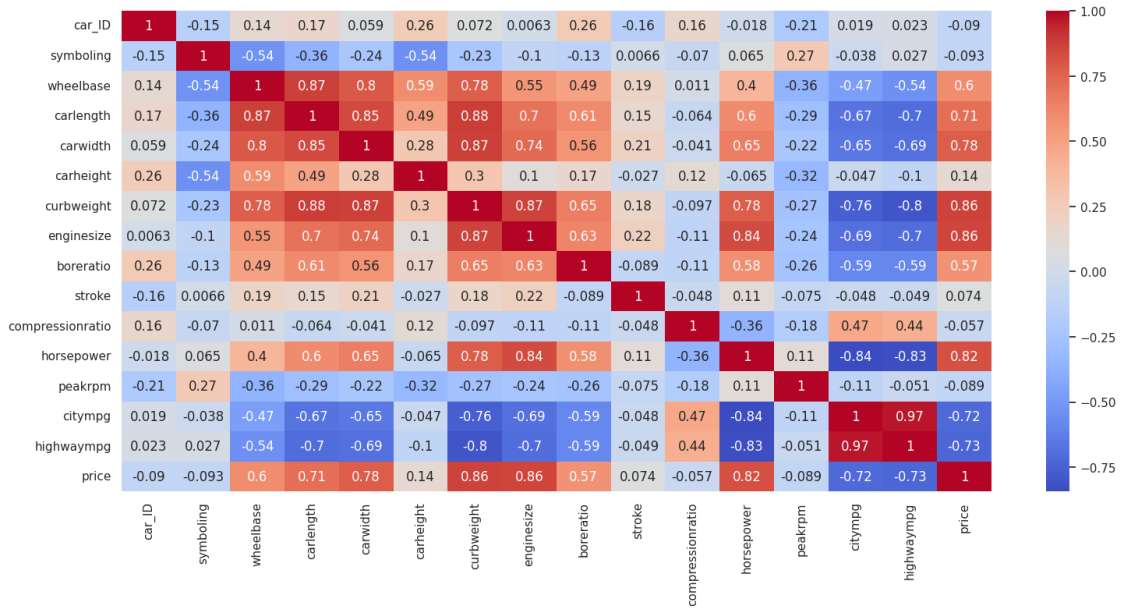





[ ]:
```
fig, ax = plt.subplots(figsize=(18, 8))
sns.heatmap(df.corr(), annot=True, cmap='coolwarm', ax=ax)
```

```
<ipython-input-295-50c0f90b2df7>:2: FutureWarning: The default value of
numeric_only in DataFrame.corr is deprecated. In a future version, it will
default to False. Select only valid columns or specify the value of numeric_only
to silence this warning.
  sns.heatmap(df.corr(), annot=True, cmap='coolwarm', ax=ax)
```

[ ]: <Axes: >



Convert Categorical Data To Number

[ ]:
```
le = LabelEncoder()
Label = df.select_dtypes(include=["object"])
df1 = df.copy()

for i in Label:
  df1[i] = le.fit_transform(df1[i])

df1.shape
```

[ ]: (205, 26)

[ ]:
```
df1.head()
```

[ ]:

	car_ID	symboling	CarName	fueltype	aspiration	doornumber	carbody	\
0	1.0	3.0	2	1	0	1	0	
1	2.0	3.0	3	1	0	1	0	
2	3.0	1.0	1	1	0	1	2	
3	4.0	2.0	4	1	0	0	3	

```
4     5.0        2.0        5         1           0           0        3

   drivewheel  enginelocation  wheelbase  …  enginesize  fuelsystem  \
0           2               0       88.6  …       130.0           5
1           2               0       88.6  …       130.0           5
2           2               0       94.5  …       152.0           5
3           1               0       99.8  …       109.0           5
4           0               0       99.4  …       136.0           5

   boreratio  stroke  compressionratio  horsepower  peakrpm  citympg  \
0       3.47    2.68               9.0       111.0   5000.0     21.0
1       3.47    2.68               9.0       111.0   5000.0     21.0
2       2.68    3.47               9.0       154.0   5000.0     19.0
3       3.19    3.40              10.0       102.0   5500.0     24.0
4       3.19    3.40               8.0       115.0   5500.0     18.0

   highwaympg    price
0        27.0  13495.0
1        27.0  16500.0
2        26.0  16500.0
3        30.0  13950.0
4        22.0  17450.0

[5 rows x 26 columns]
```

6 Feature Engineering

Mutual Information

[ ]:
```
X = df1.iloc[:,2:25]
Y = df1.iloc[:,-1]
```

[ ]:
```
X.head()
```

[ ]:
```
   CarName  fueltype  aspiration  doornumber  carbody  drivewheel  \
0        2         1           0           1        0           2
1        3         1           0           1        0           2
2        1         1           0           1        2           2
3        4         1           0           0        3           1
4        5         1           0           0        3           0

   enginelocation  wheelbase  carlength  carwidth  …  cylindernumber  \
0               0       88.6      168.8      64.1  …               2
1               0       88.6      168.8      64.1  …               2
2               0       94.5      171.2      65.5  …               3
3               0       99.8      176.6      66.2  …               2
4               0       99.4      176.6      66.4  …               1
```

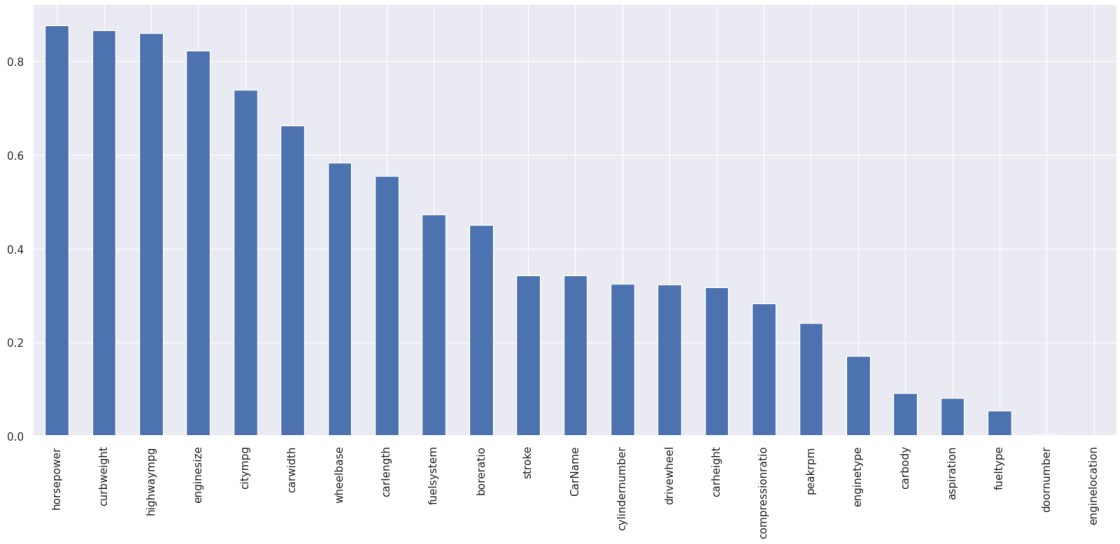
```
   enginesize  fuelsystem  boreratio  stroke  compressionratio  horsepower  \
0       130.0           5       3.47    2.68               9.0       111.0
1       130.0           5       3.47    2.68               9.0       111.0
2       152.0           5       2.68    3.47               9.0       154.0
3       109.0           5       3.19    3.40              10.0       102.0
4       136.0           5       3.19    3.40               8.0       115.0

   peakrpm  citympg  highwaympg
0   5000.0     21.0        27.0
1   5000.0     21.0        27.0
2   5000.0     19.0        26.0
3   5500.0     24.0        30.0
4   5500.0     18.0        22.0

[5 rows x 23 columns]
```

[ ]:
```
mi_score1 = mutual_info_regression(X,Y)
mi_score1 = pd.Series(mi_score1)
mi_score1.index = X.columns
mi_score1.sort_values(ascending=True)
```

[ ]:
```
enginelocation      0.000000
doornumber          0.003030
fueltype            0.053397
aspiration          0.080864
carbody             0.091125
enginetype          0.170395
peakrpm             0.241351
compressionratio    0.283008
carheight           0.317828
drivewheel          0.323140
cylindernumber      0.324994
CarName             0.342597
stroke              0.343310
boreratio           0.451031
fuelsystem          0.472714
carlength           0.555744
wheelbase           0.583592
carwidth            0.663454
citympg             0.739795
enginesize          0.822806
highwaympg          0.860714
curbweight          0.865915
horsepower          0.877749
dtype: float64
```

[ ]:
```
mi_score1.sort_values(ascending=False).plot.bar(figsize=(20, 8))
```

[ ]:
```
<Axes: >
```



Create New Feature

[ ]:
```
X.head()
```

[ ]:

	CarName	fueltype	aspiration	doornumber	carbody	drivewheel	\
0	2	1	0	1	0	2	
1	3	1	0	1	0	2	
2	1	1	0	1	2	2	
3	4	1	0	0	3	1	
4	5	1	0	0	3	0	

	enginelocation	wheelbase	carlength	carwidth	…	cylindernumber	\
0	0	88.6	168.8	64.1	…	2	
1	0	88.6	168.8	64.1	…	2	
2	0	94.5	171.2	65.5	…	3	
3	0	99.8	176.6	66.2	…	2	
4	0	99.4	176.6	66.4	…	1	

	enginesize	fuelsystem	boreratio	stroke	compressionratio	horsepower	\
0	130.0	5	3.47	2.68	9.0	111.0	
1	130.0	5	3.47	2.68	9.0	111.0	
2	152.0	5	2.68	3.47	9.0	154.0	
3	109.0	5	3.19	3.40	10.0	102.0	
4	136.0	5	3.19	3.40	8.0	115.0	

```
   peakrpm  citympg  highwaympg
0   5000.0     21.0        27.0
1   5000.0     21.0        27.0
2   5000.0     19.0        26.0
3   5500.0     24.0        30.0
4   5500.0     18.0        22.0

[5 rows x 23 columns]
```

[ ]:
```
X['engine_displacement'] = X['cylindernumber'] * X['enginesize']
X['fuel_efficiency'] = (X['citympg'] + X['highwaympg']) / 2
#X['power_to_weight_ratio'] = X['horsepower'] / X['curbweight']
#X['car_size_index'] = X['carlength'] * X['carwidth'] * X['carheight']
X['quality_index'] = (X['enginesize'] + X['horsepower'] + X['curbweight']) / 3
```

[ ]:
```
X.head()
```

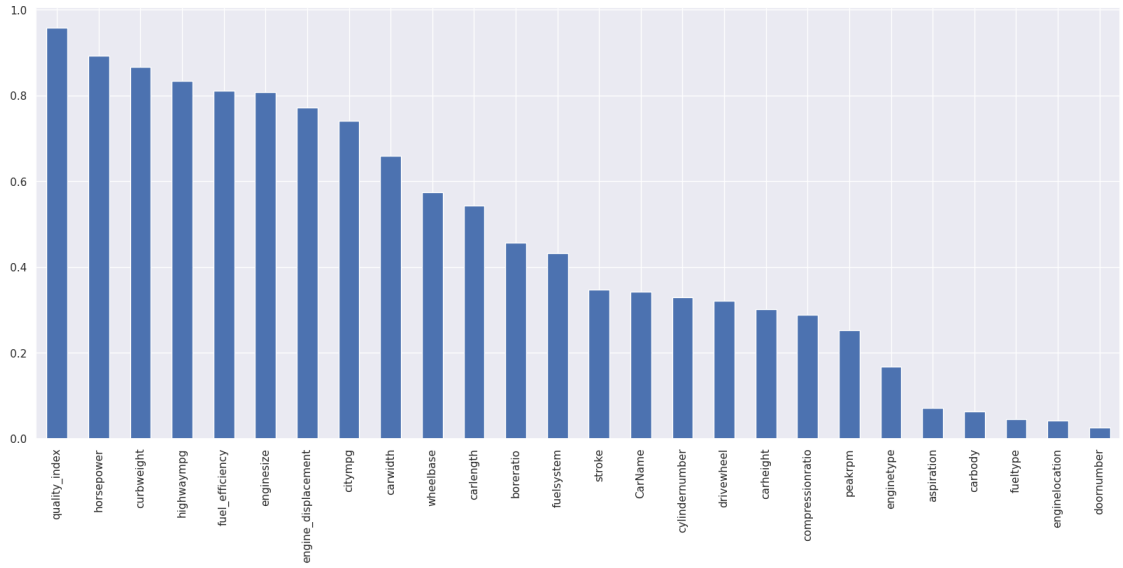
[ ]:
```
   CarName  fueltype  aspiration  doornumber  carbody  drivewheel  \
0        2         1           0           1        0           2
1        3         1           0           1        0           2
2        1         1           0           1        2           2
3        4         1           0           0        3           1
4        5         1           0           0        3           0

   enginelocation  wheelbase  carlength  carwidth  …  boreratio  stroke  \
0               0       88.6      168.8      64.1  …       3.47    2.68
1               0       88.6      168.8      64.1  …       3.47    2.68
2               0       94.5      171.2      65.5  …       2.68    3.47
3               0       99.8      176.6      66.2  …       3.19    3.40
4               0       99.4      176.6      66.4  …       3.19    3.40

   compressionratio  horsepower  peakrpm  citympg  highwaympg  \
0               9.0       111.0   5000.0     21.0        27.0
1               9.0       111.0   5000.0     21.0        27.0
2               9.0       154.0   5000.0     19.0        26.0
3              10.0       102.0   5500.0     24.0        30.0
4               8.0       115.0   5500.0     18.0        22.0

   engine_displacement  fuel_efficiency  quality_index
0                260.0             24.0     929.666667
1                260.0             24.0     929.666667
2                456.0             22.5    1043.000000
3                218.0             27.0     849.333333
4                136.0             20.0    1025.000000

[5 rows x 26 columns]
```

[ ]:
```
mi_score1 = mutual_info_regression(X,Y)
mi_score1 = pd.Series(mi_score1)
mi_score1.index = X.columns
mi_score1.sort_values(ascending=True)
```

[ ]:
```
doornumber             0.025253
enginelocation         0.041341
fueltype               0.045562
carbody                0.062457
aspiration             0.071195
enginetype             0.167651
peakrpm                0.253169
compressionratio       0.288358
carheight              0.300771
drivewheel             0.320837
cylindernumber         0.329567
CarName                0.342232
stroke                 0.347834
fuelsystem             0.431367
boreratio              0.456181
carlength              0.542398
wheelbase              0.574436
carwidth               0.658359
citympg                0.740055
engine_displacement    0.771470
enginesize             0.806962
fuel_efficiency        0.810593
highwaympg             0.833873
curbweight             0.866269
horsepower             0.891800
quality_index          0.957998
dtype: float64
```

[ ]:
```
mi_score1.sort_values(ascending=False).plot.bar(figsize=(20, 8))
```

[ ]:
```
<Axes: >
```



Splitting Data into Train And Test

[ ]:
```
train_data,test_data,train_label,test_label = train_test_split(X,Y,test_size=0.
↪3, random_state=0)
```

[ ]:
```
print("train_data : ",train_data.shape)
print("train_label : ",train_label.shape)
print("test_data : ",test_data.shape)
print("test_label : ",test_label.shape)
```

```
train_data :  (143, 26)
train_label :  (143,)
test_data :  (62, 26)
test_label :  (62,)
```

Normalize The Data

[ ]:
```
sc = StandardScaler()
train_data_sc = sc.fit_transform(train_data)
test_data_sc = sc.fit_transform(test_data)
```

[ ]:
```
train_data_sc
```

[ ]:
```
array([[-1.01906123,  0.36731544, -0.5043669 , …, -0.36552588,
         0.37067152, -0.40878809],
       [-0.50072775,  0.36731544, -0.5043669 , …, -0.19143695,
         0.20732475, -0.32650059],
       [-0.57477539,  0.36731544, -0.5043669 , …,  1.08521518,
        -1.2627962 , -0.43793158],
```

```
…,
[ 0.2644312 ,  0.36731544,  1.98268366, …, -0.01734802,
 -1.09944943,  1.0278145 ],
[-0.69818812,  0.36731544, -0.5043669 , …,  2.54320994,
 -1.75283651,  2.81585328],
[ 1.15300288,  0.36731544, -0.5043669 , …,  0.1567409 ,
 -0.11936879,  0.73809393]])
```

PCA

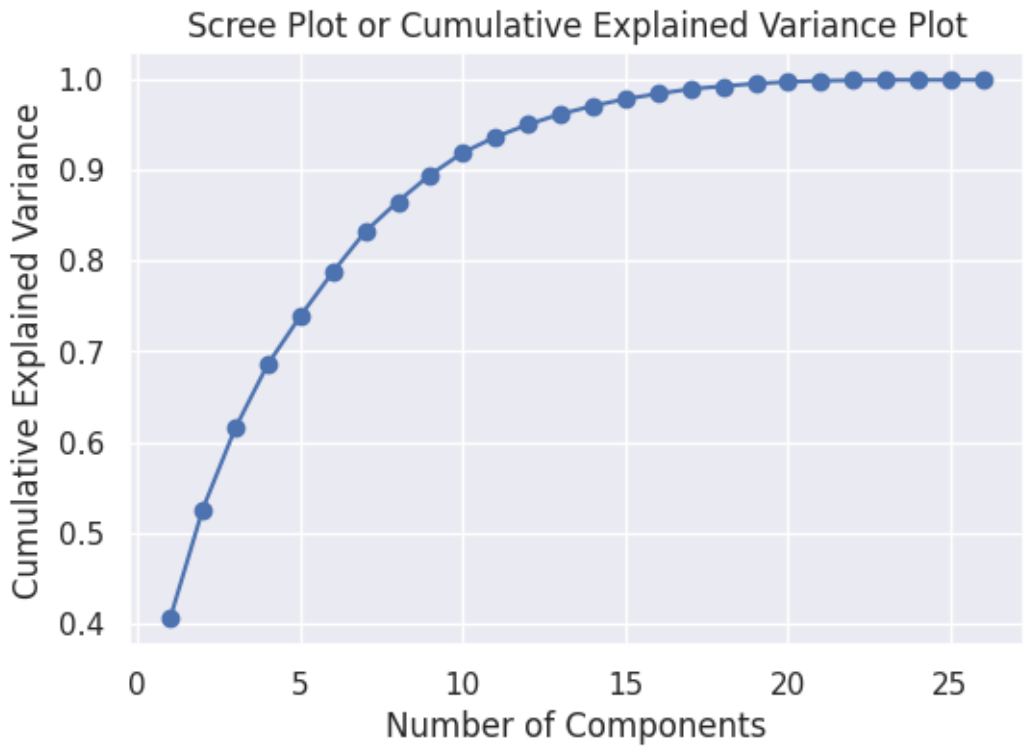
[ ]:
```
pc = PCA()
train_data_sc_pc = pc.fit_transform(train_data_sc)
test_data_sc_pc = pc.fit_transform(test_data_sc)
```

[ ]:
```
explained_variance = pc.explained_variance_ratio_
```

[ ]:
```
print("Explained Variance Ratios:", explained_variance)
```

```
Explained Variance Ratios: [4.05240221e-01 1.20489362e-01 8.94436062e-02
7.06302635e-02
 5.31723838e-02 4.86975078e-02 4.48246661e-02 3.31399706e-02
 2.96973159e-02 2.43185900e-02 1.73617345e-02 1.37067216e-02
 1.15573790e-02 8.99812508e-03 7.65990502e-03 5.75734974e-03
 5.26716929e-03 3.10786543e-03 2.93086329e-03 1.91087152e-03
 1.15635392e-03 5.99249313e-04 3.32525564e-04 2.05002042e-33
 2.05002042e-33 2.05002042e-33]
```

[ ]:
```
# calculate cumulative sum of explained variance ratio
cumulative_variance = np.cumsum(explained_variance)


# plot the scree plot or cumulative explained variance plot
plt.plot(range(1, len(explained_variance) + 1), cumulative_variance,␣
 ↪marker='o', linestyle='-')
plt.xlabel('Number of Components')
plt.ylabel('Cumulative Explained Variance')
plt.title('Scree Plot or Cumulative Explained Variance Plot')
plt.grid(True)
plt.show()
```



[ ]:
```
# Cumulative explained variance nikalen
cumulative_variance = np.cumsum(explained_variance)

# Kitne components select karna hai, yeh decide karen
desired_variance = 0.95  # Example: 95% variance ko capture karna hai

# Kitne components select kiye ja sakte hain
num_components = np.argmax(cumulative_variance >= desired_variance) + 1

print(f"\nNumber of components selected: {num_components}")
```

```
Number of components selected: 12
```

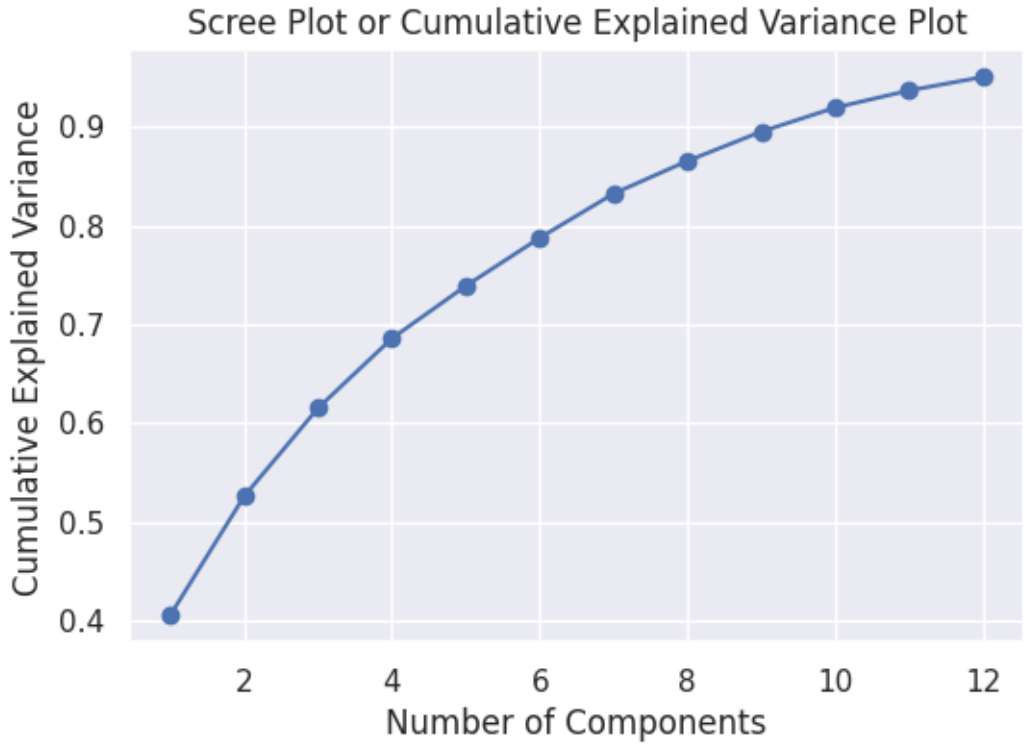
[ ]:
```
pc = PCA(n_components=12)
train_data_sc_pc = pc.fit_transform(train_data_sc)
test_data_sc_pc = pc.fit_transform(test_data_sc)
```

[ ]:
```
explained_variance = pc.explained_variance_ratio_
print("Explained Variance Ratios:", explained_variance)
```

```
Explained Variance Ratios: [0.40524022 0.12048936 0.08944361 0.07063026
0.05317238 0.04869751
```

```
0.04482467 0.03313997 0.02969732 0.02431859 0.01736173 0.01370672]
```

[ ]:
```
# calculate cumulative sum of explained variance ratio
cumulative_variance = np.cumsum(explained_variance)


# plot the scree plot or cumulative explained variance plot
plt.plot(range(1, len(explained_variance) + 1), cumulative_variance,␣
 ↪marker='o', linestyle='-')
plt.xlabel('Number of Components')
plt.ylabel('Cumulative Explained Variance')
plt.title('Scree Plot or Cumulative Explained Variance Plot')
plt.grid(True)
plt.show()
```



7 Model

Linear Regression

[ ]:
```
model_lr = LinearRegression().fit(train_data_sc_pc,train_label).
 ↪fit(train_data_sc_pc,train_label)
```

[ ]:
```
y_pred = model_lr.predict(test_data_sc_pc)
y_pred
```

[ ]:
```
array([ 8396.87721399, 18922.33914516, 14559.68841772,  1839.51844402,
         9073.51105985, 16965.46490908,  5426.93269435,  8569.91795829,
        20031.82914574,  5161.37772621, 21942.28238034, 21897.17651549,
        10959.08458335, 14908.4773158 ,  3909.59185435, 15984.98989694,
         9890.72142476, 16829.19642589,  8646.26136272,  7555.2126221 ,
         8372.02670126, 21494.94030688, 10912.47603742, 16595.33147487,
        21321.50491719, 10817.75598953,  7665.93395564, 22948.18235021,
         8844.24971301,  8324.76223141, 10475.5401981 , 10082.37346312,
        17445.7563922 , 12313.36668355,  5880.41183626, 25756.20535491,
        11110.98727662, 15904.15809371,  6182.65895425, 31946.85591744,
         5599.80038855, 13123.45742325, 29428.26942255, 18873.7336601 ,
        10816.92564135,  4828.95412917,  4065.16459744, 13139.05516393,
        11499.43338634,  8879.19076351, 16632.40849639,  6932.94004892,
        11154.1150959 , 13727.0155401 , 20152.37071232, 21807.53573437,
        11315.24687588, 17501.97764582, 11909.50563947,  4538.38068655,
         2782.68089652, 15158.56193305])
```

[ ]:
```
print("Mean Absolute Error : ",mean_absolute_error(y_pred,test_label))
print("Mean Squared Error : ",mean_squared_error(y_pred,test_label))
print("R2_Score : ",r2_score(y_pred,test_label))
```

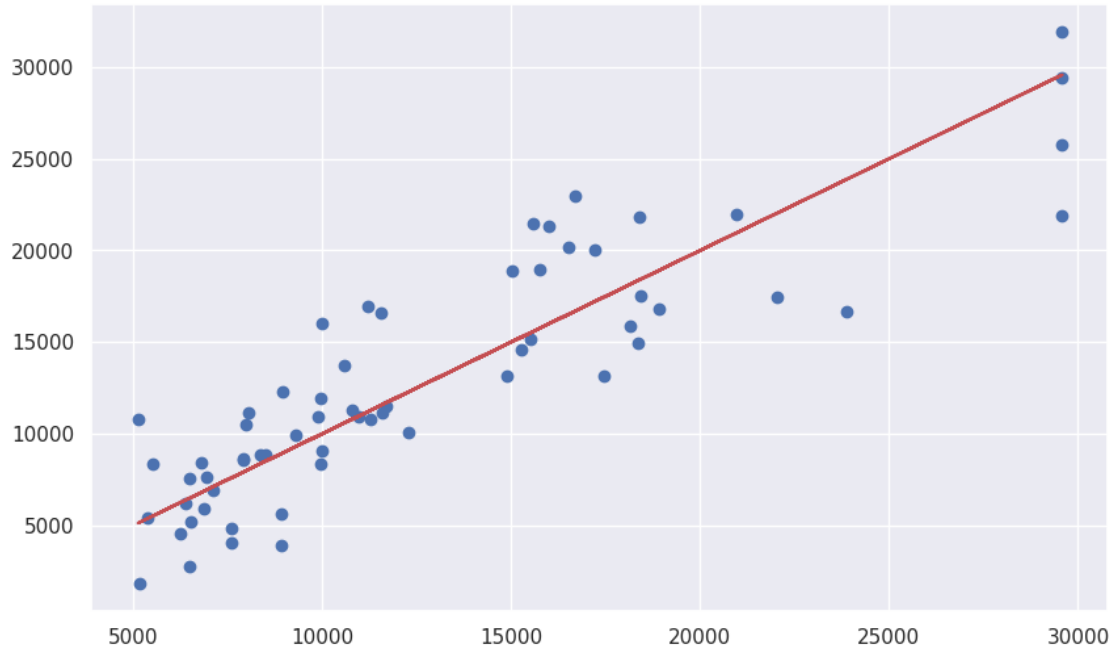
```
Mean Absolute Error :  2517.9580877776916
Mean Squared Error :  10268672.00528738
R2_Score :  0.7613593059662475
```

[ ]:
```
print(" Train Data Cross_val_score :␣
  ↪",cross_val_score(model_lr,train_data_sc_pc,train_label,cv=5).mean())
print("Test Data Cross_val_score :␣
  ↪",cross_val_score(model_lr,test_data_sc_pc,test_label,cv=5).mean())
```

```
 Train Data Cross_val_score :  0.8436586302042146
Test Data Cross_val_score :  0.7159938524184992
```

[ ]:
```
plt.figure(figsize=(10,6))
plt.scatter(test_label,y_pred)
plt.plot(test_label,test_label,'r')
```

[ ]:
```
[<matplotlib.lines.Line2D at 0x7f67f2210370>]
```



Ridge Model

[ ]:
```
model_ridge = Ridge(alpha= 1.0).fit(train_data_sc_pc,train_label)
```

[ ]:
```
y_pred_4 = model_ridge.predict(test_data_sc_pc)
```

[ ]:
```
print("Mean Absolute Error : ",mean_absolute_error(y_pred_4,test_label))
print("Mean Squared Error : ",mean_squared_error(y_pred_4,test_label))
print("R2_Score : ",r2_score(y_pred_4,test_label))
```

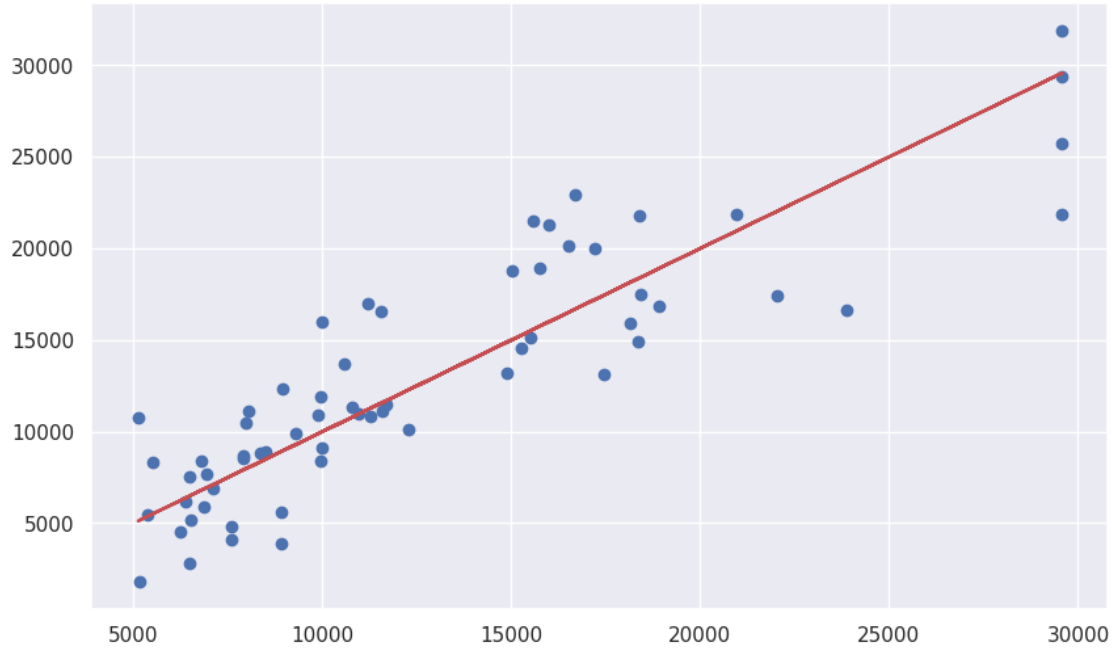
```
Mean Absolute Error :  2512.094425773144
Mean Squared Error :  10223179.038446791
R2_Score :  0.7616714505579733
```

[ ]:
```
print(" Train Data Cross_val_score :␣
  ↪",cross_val_score(model_ridge,train_data_sc_pc,train_label,cv=5).mean())
print("Test Data Cross_val_score :␣
  ↪",cross_val_score(model_ridge,test_data_sc_pc,test_label,cv=5).mean())
```

```
 Train Data Cross_val_score :  0.8437069666470807
Test Data Cross_val_score :  0.7262022724480766
```

[ ]:
```
plt.figure(figsize=(10,6))
plt.scatter(test_label,y_pred_4)
plt.plot(test_label,test_label,'r')
```

[ ]: [<matplotlib.lines.Line2D at 0x7f67e5340130>]



Random Forest Model

[ ]:
```
model_rf = RandomForestRegressor(max_depth= None, n_estimators= 200).
  ↪fit(train_data_sc_pc,train_label)
```

[ ]:
```
model_rf.score(train_data_sc_pc,train_label)
```

[ ]: 0.9849200112110187

[ ]:
```
y_pred_2 = model_rf.predict(test_data_sc_pc)
```

[ ]:
```
print("Mean Absolute Error : ",mean_absolute_error(y_pred_2,test_label))
print("Mean Squared Error : ",mean_squared_error(y_pred_2,test_label))
print("R2_Score : ",r2_score(y_pred_2,test_label))
```

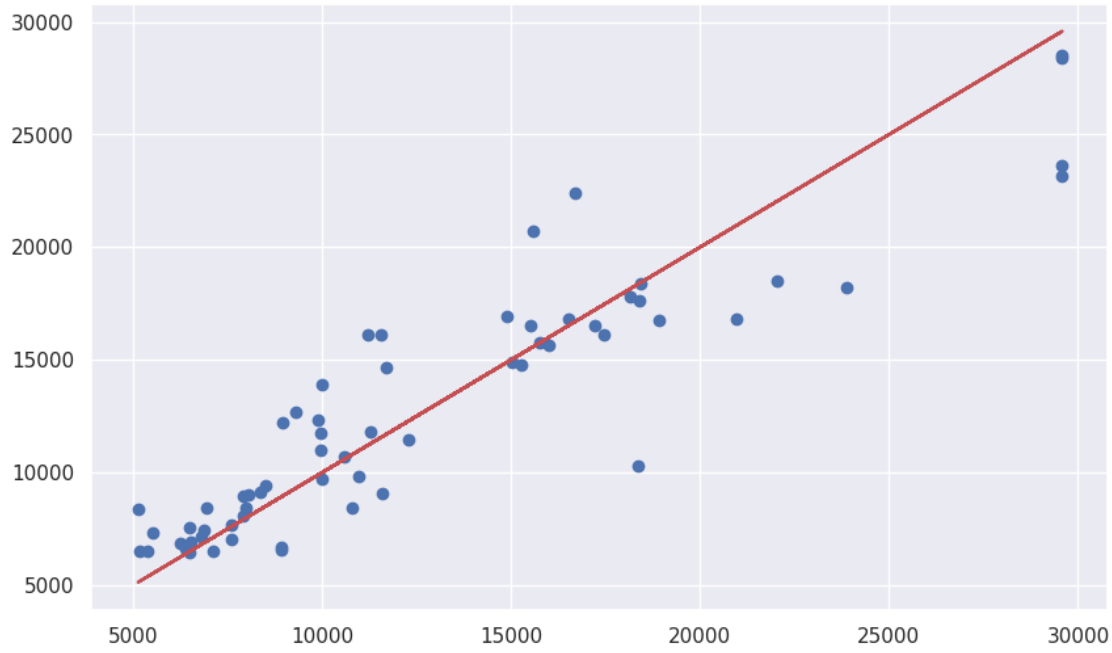
```
Mean Absolute Error :  1855.7153616935486
Mean Squared Error :  6944779.265158089
R2_Score :  0.772396522880537
```

[ ]:
```
print(" Train Data Cross_val_score :␣
  ↪",cross_val_score(model_rf,train_data_sc_pc,train_label,cv=5).mean())
print("Test Data Cross_val_score :␣
  ↪",cross_val_score(model_rf,test_data_sc_pc,test_label,cv=5).mean())
```

```
 Train Data Cross_val_score :  0.8665114703003836
Test Data Cross_val_score :  0.7398572840313276
```

[ ]:
```
plt.figure(figsize=(10,6))
plt.scatter(test_label,y_pred_2)
plt.plot(test_label,test_label,'r')
```

[ ]:
```
[<matplotlib.lines.Line2D at 0x7f67f1f48a90>]
```



Decision Tree Model

[ ]:
```
model_tree = DecisionTreeRegressor(max_depth= 5, min_samples_leaf= 1,␣
↪min_samples_split = 10).fit(train_data_sc_pc,train_label)
```

[ ]:
```
y_pred_3 = model_tree.predict(test_data_sc_pc)
```

[ ]:
```
print("Mean Absolute Error : ",mean_absolute_error(y_pred_3,test_label))
print("Mean Squared Error : ",mean_squared_error(y_pred_3,test_label))
print("R2_Score : ",r2_score(y_pred_3,test_label))
```

```
Mean Absolute Error :  2153.615852360005
Mean Squared Error :  8908624.269623565
R2_Score :  0.7508070828059172
```

[ ]:
```
print(" Train Data Cross_val_score :␣
↪",cross_val_score(model_tree,train_data_sc_pc,train_label,cv=5).mean())
```

```
print("Test Data Cross_val_score :␣
  ↪",cross_val_score(model_tree,test_data_sc_pc,test_label,cv=5).mean())
```

```
 Train Data Cross_val_score :  0.8276322278415007
Test Data Cross_val_score :  0.6503959943276734
```

[ ]:
```
plt.figure(figsize=(10,6))
plt.scatter(test_label,y_pred_2)
plt.plot(test_label,test_label,'r')
```

[ ]:
```
[<matplotlib.lines.Line2D at 0x7f67ea0af2e0>]
```