```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
from sklearn.preprocessing import StandardScaler
from sklearn.model_selection import train_test_split
from sklearn.cluster import KMeans


from google.colab import drive
drive.mount('/content/drive')
```

```
Drive already mounted at /content/drive; to attempt to forcibly remount, call drive.mount("/content/drive", force_remount=True).
```

```
file_path = '/content/drive/MyDrive/auto_new.csv'



Start coding or generate with AI.


df=pd.read_csv(file_path)


print(df)
```

Show hidden output

```
print(df.describe())
```

```
             Class  wheel_base      length       width      height  \
count  205.000000  205.000000  205.000000  205.000000  205.000000
mean     0.834146   98.756585  174.049268   65.907805   53.724878
std      1.245307    6.021776   12.337289    2.145204    2.443522
min     -2.000000   86.600000  141.100000   60.300000   47.800000
25%      0.000000   94.500000  166.300000   64.100000   52.000000
50%      1.000000   97.000000  173.200000   65.500000   54.100000
75%      2.000000  102.400000  183.100000   66.900000   55.500000
max      3.000000  120.900000  208.100000   72.300000   59.800000

       curb_height  engine_size  compression _ratio  horsepower    city_mpg  \
count   205.000000   205.000000          205.000000  205.000000  205.000000
mean   2555.565854   126.907317           10.142537  103.951220   25.219512
std     520.680204    41.642693            3.972040   39.639028    6.542142
min    1488.000000    61.000000            7.000000   48.000000   13.000000
25%    2145.000000    97.000000            8.600000   70.000000   19.000000
50%    2414.000000   120.000000            9.000000   95.000000   24.000000
75%    2935.000000   141.000000            9.400000  116.000000   30.000000
max    4066.000000   326.000000           23.000000  288.000000   49.000000

       highway_mpg         price
count   205.000000    205.000000
mean     30.751220  13354.302439
std       6.886443   8079.656560
min      16.000000   5118.000000
25%      25.000000   7788.000000
50%      30.000000  10595.000000
75%      34.000000  16503.000000
max      54.000000  45400.000000
```

```
df = df.replace('?', pd.NA)
numeric_columns = ['Class',  'wheel_base', 'length', 'width', 'height',
                   'curb_height', 'engine_size', 'bore', 'stroke', 'compression _ratio',
                   'horsepower', 'peal_rpm', 'city_mpg', 'highway_mpg', 'price']
df[numeric_columns] = df[numeric_columns].apply(pd.to_numeric, errors='coerce')
df = df.dropna()


categorical_columns = ['Make', 'Fuel_type', 'Aspiration', 'Num_doors', 'body_style',
                       'drive_wheels', 'engine_location', 'engine_type', 'num_cylinders', 'fuel_system']
unique_values_counts = {col: df[col].value_counts() for col in categorical_columns}
for col, counts in unique_values_counts.items():
    print(f"Unique values for {col}:\n{counts}\n")
```

Show hidden output

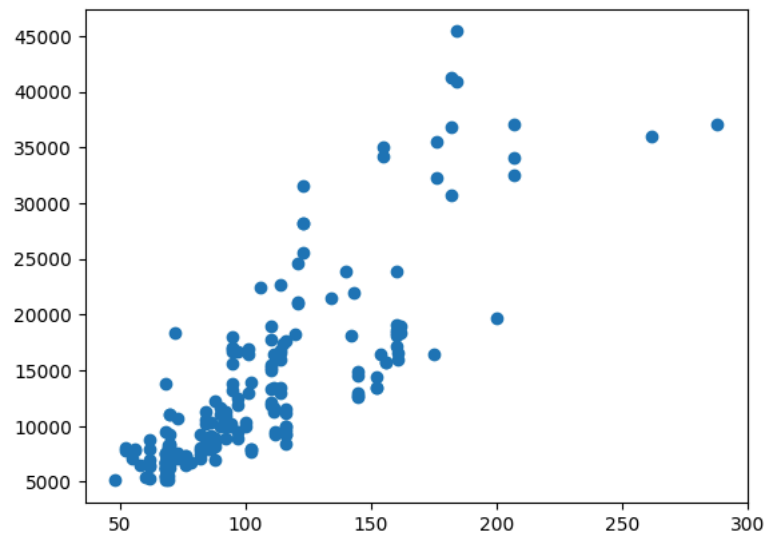
```
df.describe()
```

	Class	wheel_base	length	width	height	curb_height	engine_
count	197.000000	197.000000	197.000000	197.000000	197.000000	197.000000	197.00
mean	0.791878	98.879188	174.165990	65.913198	53.824365	2561.284264	128.13
std	1.225717	6.105770	12.492492	2.181772	2.393170	529.971486	41.68
min	-2.000000	86.600000	141.100000	60.300000	47.800000	1488.000000	61.00
25%	0.000000	94.500000	166.300000	64.000000	52.000000	2140.000000	98.00
50%	1.000000	97.000000	173.200000	65.400000	54.100000	2414.000000	120.00
75%	2.000000	102.400000	183.500000	66.900000	55.600000	2954.000000	146.00

```
print(df.isnull().sum())
```

```
Class                0
Make                 0
Fuel_type            0
Aspiration           0
Num_doors            0
body_style           0
drive_wheels         0
engine_location      0
wheel_base           0
length               0
width                0
height               0
curb_height          0
engine_type          0
num_cylinders        0
engine_size          0
fuel_system          0
bore                 0
stroke               0
compression _ratio    0
horsepower           0
peal_rpm             0
city_mpg             0
highway_mpg          0
price                0
dtype: int64
```

```
#Selecting features for clustering
features = df[['wheel_base', 'length', 'width', 'height', 'curb_height', 'engine_size', 'bore', 'stroke',
               'compression _ratio', 'horsepower', 'peal_rpm', 'city_mpg', 'highway_mpg', 'price']]


plt.scatter(df['horsepower'],df['price'])
plt.show()
print("This is very bad for analysis process so we will analyse the car by cluster.")
```




```
This is very bad for analysis process so we will analyse the car by cluster.
```

```
non_numeric_values = df[['horsepower', 'price']].applymap(lambda x: pd.isna(pd.to_numeric(x, errors='ignore')))

# Print the number of non-numeric values in each column
print(non_numeric_values.sum())
```

```
horsepower    0
price         0
dtype: int64
```

```
km=KMeans(n_clusters=5)
```

```
print(km)
```

```
KMeans(n_clusters=5)
```

```
Y=km.fit_predict(df[['horsepower','price']])
print(Y)
```

Show hidden output

```
df["Cluster"]=Y
print(df)
df0=df[df.Cluster==0]
df1=df[df.Cluster==1]
df2=df[df.Cluster==2]
df3=df[df.Cluster==3]
df4=df[df.Cluster==4]
print(df0)
print(df1)
print(df2)
print(df3)
print(df4)
plt.scatter(df0.horsepower,df0.price,color='green')
plt.scatter(df1.horsepower,df1.price,color='red')
plt.scatter(df2.horsepower,df2.price,color='black')
plt.scatter(df3.horsepower,df3.price,color='blue')
plt.scatter(df4.horsepower,df4.price,color='yellow')
plt.show()
```

```
     Class         Make Fuel_type Aspiration Num_doors   body_style  \
0        3  alfa-romero       gas        std       two  convertible
1        3  alfa-romero       gas        std       two  convertible
2        1  alfa-romero       gas        std       two    hatchback
3        2         audi       gas        std      four        sedan
4        2         audi       gas        std      four        sedan
..     ...          ...       ...        ...       ...          ...
200     -1        volvo       gas        std      four        sedan
201     -1        volvo       gas      turbo      four        sedan
202     -1        volvo       gas        std      four        sedan
203     -1        volvo    diesel      turbo      four        sedan
204     -1        volvo       gas      turbo      four        sedan

    drive_wheels engine_location  wheel_base  length  ...  fuel_system  bore  \
0            rwd           front        88.6   168.8  ...         mpfi  3.47
1            rwd           front        88.6   168.8  ...         mpfi  3.47
2            rwd           front        94.5   171.2  ...         mpfi  2.68
3            fwd           front        99.8   176.6  ...         mpfi  3.19
4            4wd           front        99.4   176.6  ...         mpfi  3.19
..           ...             ...         ...     ...  ...          ...   ...
200          rwd           front       109.1   188.8  ...         mpfi  3.78
201          rwd           front       109.1   188.8  ...         mpfi  3.78
202          rwd           front       109.1   188.8  ...         mpfi  3.58
203          rwd           front       109.1   188.8  ...          idi  3.01
204          rwd           front       109.1   188.8  ...         mpfi  3.78

     stroke compression _ratio horsepower  peal_rpm city_mpg  highway_mpg  \
0      2.68                9.0        111    5000.0       21           27
1      2.68                9.0        111    5000.0       21           27
2      3.47                9.0        154    5000.0       19           26
3      3.40               10.0        102    5500.0       24           30
4      3.40                8.0        115    5500.0       18           22
..      ...                ...        ...       ...      ...          ...
200    3.15                9.5        114    5400.0       23           28
201    3.15                8.7        160    5300.0       19           25
202    2.87                8.8        134    5500.0       18           23
203    3.40               23.0        106    4800.0       26           27
204    3.15                9.5        114    5400.0       19           25

     price  Cluster
0    13495        3
1    16500        2
2    16500        2
3    13950        3
4    17450        2
..     ...      ...
200  16845        2
201  19045        2
202  21485        4
203  22470        4
204  22625        4

[197 rows x 26 columns]
     Class        Make Fuel_type Aspiration Num_doors body_style drive_wheels  \
18       2   chevrolet       gas        std       two  hatchback          fwd
19       1   chevrolet       gas        std       two  hatchback          fwd
20       0   chevrolet       gas        std      four      sedan          fwd
21       1       dodge       gas        std       two  hatchback          fwd
22       1       dodge       gas        std       two  hatchback          fwd
..     ...         ...       ...        ...       ...        ...          ...
182      2  volkswagen    diesel        std       two      sedan          fwd
183      2  volkswagen       gas        std       two      sedan          fwd
184      2  volkswagen    diesel        std      four      sedan          fwd
185      2  volkswagen       gas        std      four      sedan          fwd
186      2  volkswagen       gas        std      four      sedan          fwd

    engine_location  wheel_base  length  ...  fuel_system  bore  stroke  \
18            front        88.4   141.1  ...         2bbl  2.91    3.03
19            front        94.5   155.9  ...         2bbl  3.03    3.11
20            front        94.5   158.8  ...         2bbl  3.03    3.11
21            front        93.7   157.3  ...         2bbl  2.97    3.23
22            front        93.7   157.3  ...         2bbl  2.97    3.23
..              ...         ...     ...  ...          ...   ...     ...
182           front        97.3   171.7  ...          idi  3.01    3.40
183           front        97.3   171.7  ...         mpfi  3.19    3.40
184           front        97.3   171.7  ...          idi  3.01    3.40
185           front        97.3   171.7  ...         mpfi  3.19    3.40
186           front        97.3   171.7  ...         mpfi  3.19    3.40

    compression _ratio horsepower  peal_rpm city_mpg  highway_mpg  price  \
18                9.50         48    5100.0       47           53   5151
19                9.60         70    5400.0       38           43   6295
20                9.60         70    5400.0       38           43   6575
21                9.41         68    5500.0       37           41   5572
22                9.40         68    5500.0       31           38   6377
..                 ...        ...       ...      ...          ...    ...
182              23.00         52    4800.0       37           46   7775
183               9.00         85    5250.0       27           34   7975
184              23.00         52    4800.0       37           46   7995
185               9.00         85    5250.0       27           34   8195
```

```
186              9.00         85    5250.0       27           34   8495

     Cluster
18         0
19         0
20         0
21         0
22         0
..       ...
182        0
183        0
184        0
185        0
186        0

[85 rows x 26 columns]
     Class           Make Fuel_type Aspiration Num_doors   body_style  \
15       0            bmw       gas        std       four        sedan
16       0            bmw       gas        std        two        sedan
17       0            bmw       gas        std       four        sedan
47       0         jaguar       gas        std       four        sedan
48       0         jaguar       gas        std       four        sedan
49       0         jaguar       gas        std        two        sedan
70      -1  mercedes-benz    diesel      turbo       four        sedan
71      -1  mercedes-benz       gas        std       four        sedan
72       3  mercedes-benz       gas        std        two  convertible
73       0  mercedes-benz       gas        std       four        sedan
74       1  mercedes-benz       gas        std        two      hardtop
126      3        porsche       gas        std        two      hardtop
127      3        porsche       gas        std        two      hardtop
128      3        porsche       gas        std        two  convertible
129      1        porsche       gas        std        two    hatchback

    drive_wheels engine_location  wheel_base  length  ...  fuel_system  bore  \
15           rwd           front       103.5   189.0  ...         mpfi  3.62
16           rwd           front       103.5   193.8  ...         mpfi  3.62
17           rwd           front       110.0   197.0  ...         mpfi  3.62
47           rwd           front       113.0   199.6  ...         mpfi  3.63
48           rwd           front       113.0   199.6  ...         mpfi  3.63
49           rwd           front       102.0   191.7  ...         mpfi  3.54
70           rwd           front       115.6   202.6  ...          idi  3.58
71           rwd           front       115.6   202.6  ...         mpfi  3.46
72           rwd           front        96.6   180.3  ...         mpfi  3.46
73           rwd           front       120.9   208.1  ...         mpfi  3.80
74           rwd           front       112.0   199.2  ...         mpfi  3.80
126          rwd            rear        89.5   168.9  ...         mpfi  3.74
127          rwd            rear        89.5   168.9  ...         mpfi  3.74
128          rwd            rear        89.5   168.9  ...         mpfi  3.74
129          rwd           front        98.4   175.7  ...         mpfi  3.94

     stroke compression _ratio horsepower  peal_rpm city_mpg  highway_mpg  \
15     3.39                8.0        182    5400.0       16           22
16     3.39                8.0        182    5400.0       16           22
17     3.39                8.0        182    5400.0       15           20
47     4.17                8.1        176    4750.0       15           19
48     4.17                8.1        176    4750.0       15           19
49     2.76               11.5        262    5000.0       13           17
70     3.64               21.5        123    4350.0       22           25
71     3.10                8.3        155    4750.0       16           18
72     3.10                8.3        155    4750.0       16           18
73     3.35                8.0        184    4500.0       14           16
74     3.35                8.0        184    4500.0       14           16
126    2.90                9.5        207    5900.0       17           25
127    2.90                9.5        207    5900.0       17           25
128    2.90                9.5        207    5900.0       17           25
129    3.11               10.0        288    5750.0       17           28

     price  Cluster
15   30760        1
16   41315        1
17   36880        1
47   32250        1
48   35550        1
49   36000        1
70   31600        1
71   34184        1
72   35056        1
73   40960        1
74   45400        1
126  32528        1
127  34028        1
128  37028        1
129  37028        1

[15 rows x 26 columns]
     Class         Make Fuel_type Aspiration Num_doors   body_style  \
1        3  alfa-romero       gas        std       two  convertible
2        1  alfa-romero       gas        std       two    hatchback
4        2         audi       gas        std      four        sedan
5        2         audi       gas        std       two        sedan
6        1         audi       gas        std      four        sedan
```

7	1	audi	gas	std	four	wagon
10	2	bmw	gas	std	two	sedan
11	0	bmw	gas	std	four	sedan
65	0	mazda	gas	std	four	sedan
66	0	mazda	diesel	std	four	sedan
75	1	mercury	gas	turbo	two	hatchback
83	3	mitsubishi	gas	turbo	two	hatchback
84	3	mitsubishi	gas	turbo	two	hatchback
102	0	nissan	gas	std	four	wagon
104	3	nissan	gas	std	two	hatchback
105	3	nissan	gas	turbo	two	hatchback
106	1	nissan	gas	std	two	hatchback
111	0	peugot	gas	std	four	sedan
112	0	peugot	diesel	turbo	four	sedan
113	0	peugot	gas	std	four	wagon
114	0	peugot	diesel	turbo	four	wagon
115	0	peugot	gas	std	four	sedan
116	0	peugot	diesel	turbo	four	sedan
117	0	peugot	gas	turbo	four	sedan
134	3	saab	gas	std	two	hatchback
135	2	saab	gas	std	four	sedan
136	3	saab	gas	turbo	two	hatchback
137	2	saab	gas	turbo	four	sedan
172	2	toyota	gas	std	two	convertible
178	3	toyota	gas	std	two	hatchback
179	3	toyota	gas	std	two	hatchback
180	-1	toyota	gas	std	four	sedan
181	-1	toyota	gas	std	four	wagon
196	-2	volvo	gas	std	four	sedan
197	-1	volvo	gas	std	four	wagon
198	-2	volvo	gas	turbo	four	sedan
199	-1	volvo	gas	turbo	four	wagon
200	-1	volvo	gas	std	four	sedan
201	-1	volvo	gas	turbo	four	sedan

	drive_wheels	engine_location	wheel_base	length	...	fuel_system	bore	\
1	rwd	front	88.6	168.8	...	mpfi	3.47	
2	rwd	front	94.5	171.2	...	mpfi	2.68	
4	4wd	front	99.4	176.6	...	mpfi	3.19	
5	fwd	front	99.8	177.3	...	mpfi	3.19	
6	fwd	front	105.8	192.7	...	mpfi	3.19	
7	fwd	front	105.8	192.7	...	mpfi	3.19	
10	rwd	front	101.2	176.8	...	mpfi	3.50	
11	rwd	front	101.2	176.8	...	mpfi	3.50	
65	rwd	front	104.9	175.0	...	mpfi	3.76	
66	rwd	front	104.9	175.0	...	idi	3.43	
75	rwd	front	102.7	178.4	...	mpfi	3.78	
83	fwd	front	95.9	173.2	...	spdi	3.59	
84	fwd	front	95.9	173.2	...	spdi	3.59	
102	fwd	front	100.4	184.6	...	mpfi	3.43	
104	rwd	front	91.3	170.7	...	mpfi	3.43	
105	rwd	front	91.3	170.7	...	mpfi	3.43	
106	rwd	front	99.2	178.5	...	mpfi	3.43	
111	rwd	front	107.9	186.7	...	mpfi	3.46	
112	rwd	front	107.9	186.7	...	idi	3.70	
113	rwd	front	114.2	198.9	...	mpfi	3.46	
114	rwd	front	114.2	198.9	...	idi	3.70	
115	rwd	front	107.9	186.7	...	mpfi	3.46	
116	rwd	front	107.9	186.7	...	idi	3.70	
117	rwd	front	108.0	186.7	...	mpfi	3.61	
134	fwd	front	99.1	186.6	...	mpfi	2.54	
135	fwd	front	99.1	186.6	...	mpfi	3.54	
136	fwd	front	99.1	186.6	...	mpfi	3.54	
137	fwd	front	99.1	186.6	...	mpfi	3.54	
172	rwd	front	98.4	176.2	...	mpfi	3.62	
178	rwd	front	102.9	183.5	...	mpfi	3.27	
179	rwd	front	102.9	183.5	...	mpfi	3.27	
180	rwd	front	104.5	187.8	...	mpfi	3.27	
181	rwd	front	104.5	187.8	...	mpfi	3.27	
196	rwd	front	104.3	188.8	...	mpfi	3.78	
197	rwd	front	104.3	188.8	...	mpfi	3.78	
198	rwd	front	104.3	188.8	...	mpfi	3.62	
199	rwd	front	104.3	188.8	...	mpfi	3.62	
200	rwd	front	109.1	188.8	...	mpfi	3.78	
201	rwd	front	109.1	188.8	...	mpfi	3.78	

	stroke	compression _ratio	horsepower	peal_rpm	city_mpg	highway_mpg	\
1	2.68	9.0	111	5000.0	21	27	
2	3.47	9.0	154	5000.0	19	26	
4	3.40	8.0	115	5500.0	18	22	
5	3.40	8.5	110	5500.0	19	25	
6	3.40	8.5	110	5500.0	19	25	
7	3.40	8.5	110	5500.0	19	25	
10	2.80	8.8	101	5800.0	23	29	
11	2.80	8.8	101	5800.0	23	29	
65	3.16	8.0	120	5000.0	19	27	
66	3.64	22.0	72	4200.0	31	39	
75	3.12	8.0	175	5000.0	19	24	
83	3.86	7.0	145	5000.0	19	24	
84	3.86	7.0	145	5000.0	19	24	

```
102    3.27               9.0        152    5200.0       17           22
104    3.27               9.0        160    5200.0       19           25
105    3.27               7.8        200    5200.0       17           23
106    3.27               9.0        160    5200.0       19           25
111    2.19               8.4         95    5000.0       19           24
112    3.52              21.0         95    4150.0       28           33
113    2.19               8.4         95    5000.0       19           24
114    3.52              21.0         95    4150.0       25           25
115    3.19               8.4         97    5000.0       19           24
116    3.52              21.0         95    4150.0       28           33
117    3.21               7.0        142    5600.0       18           24
134    2.07               9.3        110    5250.0       21           28
135    3.07               9.3        110    5250.0       21           28
136    3.07               9.0        160    5500.0       19           26
137    3.07               9.0        160    5500.0       19           26
172    3.50               9.3        116    4800.0       24           30
178    3.35               9.3        161    5200.0       20           24
179    3.35               9.3        161    5200.0       19           24
180    3.35               9.2        156    5200.0       20           24
181    3.35               9.2        156    5200.0       19           24
196    3.15               9.5        114    5400.0       24           28
197    3.15               9.5        114    5400.0       24           28
198    3.15               7.5        162    5100.0       17           22
199    3.15               7.5        162    5100.0       17           22
200    3.15               9.5        114    5400.0       23           28
201    3.15               8.7        160    5300.0       19           25

     price  Cluster
1    16500        2
2    16500        2
4    17450        2
5    15250        2
6    17710        2
7    18920        2
10   16430        2
11   16925        2
65   18280        2
66   18344        2
75   16503        2
83   14869        2
84   14489        2
102  14399        2
104  17199        2
105  19699        2
106  18399        2
111  15580        2
112  16900        2
113  16695        2
114  17075        2
115  16630        2
116  17950        2
117  18150        2
134  15040        2
135  15510        2
136  18150        2
137  18620        2
172  17669        2
178  16558        2
179  15998        2
180  15690        2
181  15750        2
196  15985        2
197  16515        2
198  18420        2
199  18950        2
200  16845        2
201  19045        2

[39 rows x 26 columns]
     Class         Make Fuel_type Aspiration Num_doors   body_style  \
0        3  alfa-romero       gas        std       two  convertible
3        2         audi       gas        std      four        sedan
29       3        dodge       gas      turbo       two    hatchback
40       0        honda       gas        std      four        sedan
41       0        honda       gas        std      four        sedan
42       1        honda       gas        std       two        sedan
44       1        isuzu       gas        std       two        sedan
45       0        isuzu       gas        std      four        sedan
46       2        isuzu       gas        std       two    hatchback
61       1        mazda       gas        std       two    hatchback
62       0        mazda       gas        std      four        sedan
64       0        mazda       gas        std      four    hatchback
80       3   mitsubishi       gas      turbo       two    hatchback
82       3   mitsubishi       gas      turbo       two    hatchback
100      0       nissan       gas        std      four        sedan
101      0       nissan       gas        std      four        sedan
103      0       nissan       gas        std      four        sedan
107      0       peugot       gas        std      four        sedan
108      0       peugot    diesel      turbo      four        sedan
109      0       peugot       gas        std      four        wagon
110      0       peugot    diesel      turbo      four        wagon
```

110	0	peugot	diesel	turbo	four	wagon
124	3	plymouth	gas	turbo	two	hatchback
132	3	saab	gas	std	two	hatchback
133	2	saab	gas	std	four	sedan
143	0	subaru	gas	std	four	sedan
145	0	subaru	gas	turbo	four	sedan
147	0	subaru	gas	std	four	wagon
149	0	subaru	gas	turbo	four	wagon
166	1	toyota	gas	std	two	hatchback
168	2	toyota	gas	std	two	hardtop
169	2	toyota	gas	std	two	hatchback
170	2	toyota	gas	std	two	hardtop
171	2	toyota	gas	std	two	hatchback
174	-1	toyota	diesel	turbo	four	sedan
175	-1	toyota	gas	std	four	hatchback
176	-1	toyota	gas	std	four	sedan
177	-1	toyota	gas	std	four	hatchback
187	2	volkswagen	diesel	turbo	four	sedan
188	2	volkswagen	gas	std	four	sedan
189	3	volkswagen	gas	std	two	convertible
190	3	volkswagen	gas	std	two	hatchback
191	0	volkswagen	gas	std	four	sedan
192	0	volkswagen	diesel	turbo	four	sedan
193	0	volkswagen	gas	std	four	wagon
194	-2	volvo	gas	std	four	sedan
195	-1	volvo	gas	std	four	wagon

	drive_wheels	engine_location	wheel_base	length	...	fuel_system	bore	\
0	rwd	front	88.6	168.8	...	mpfi	3.47	
3	fwd	front	99.8	176.6	...	mpfi	3.19	
29	fwd	front	95.9	173.2	...	mfi	3.60	
40	fwd	front	96.5	175.4	...	1bbl	3.15	
41	fwd	front	96.5	175.4	...	mpfi	3.15	
42	fwd	front	96.5	169.1	...	2bbl	3.15	
44	fwd	front	94.5	155.9	...	2bbl	3.03	
45	fwd	front	94.5	155.9	...	2bbl	3.03	
46	rwd	front	96.0	172.6	...	spfi	3.43	
61	fwd	front	98.8	177.8	...	2bbl	3.39	
62	fwd	front	98.8	177.8	...	2bbl	3.39	
64	fwd	front	98.8	177.8	...	2bbl	3.39	
80	fwd	front	96.3	173.0	...	spdi	3.17	
82	fwd	front	95.9	173.2	...	spdi	3.58	
100	fwd	front	97.2	173.4	...	2bbl	3.33	
101	fwd	front	100.4	181.7	...	mpfi	3.43	
103	fwd	front	100.4	184.6	...	mpfi	3.43	
107	rwd	front	107.9	186.7	...	mpfi	3.46	
108	rwd	front	107.9	186.7	...	idi	3.70	
109	rwd	front	114.2	198.9	...	mpfi	3.46	
110	rwd	front	114.2	198.9	...	idi	3.70	
124	rwd	front	95.9	173.2	...	spdi	3.59	
132	fwd	front	99.1	186.6	...	mpfi	3.54	
133	fwd	front	99.1	186.6	...	mpfi	3.54	
143	fwd	front	97.2	172.0	...	mpfi	3.62	
145	4wd	front	97.0	172.0	...	mpfi	3.62	
147	fwd	front	97.0	173.5	...	mpfi	3.62	
149	4wd	front	96.9	173.6	...	mpfi	3.62	
166	rwd	front	94.5	168.7	...	mpfi	3.24	
168	rwd	front	98.4	176.2	...	mpfi	3.62	
169	rwd	front	98.4	176.2	...	mpfi	3.62	
170	rwd	front	98.4	176.2	...	mpfi	3.62	
171	rwd	front	98.4	176.2	...	mpfi	3.62	
174	fwd	front	102.4	175.6	...	idi	3.27	
175	fwd	front	102.4	175.6	...	mpfi	3.31	
176	fwd	front	102.4	175.6	...	mpfi	3.31	
177	fwd	front	102.4	175.6	...	mpfi	3.31	
187	fwd	front	97.3	171.7	...	idi	3.01	
188	fwd	front	97.3	171.7	...	mpfi	3.19	
189	fwd	front	94.5	159.3	...	mpfi	3.19	
190	fwd	front	94.5	165.7	...	mpfi	3.19	
191	fwd	front	100.4	180.2	...	mpfi	3.19	
192	fwd	front	100.4	180.2	...	idi	3.01	
193	fwd	front	100.4	183.1	...	mpfi	3.19	
194	rwd	front	104.3	188.8	...	mpfi	3.78	
195	rwd	front	104.3	188.8	...	mpfi	3.78	

	stroke	compression _ratio	horsepower	peal_rpm	city_mpg	highway_mpg	\
0	2.68	9.00	111	5000.0	21	27	
3	3.40	10.00	102	5500.0	24	30	
29	3.90	7.00	145	5000.0	19	24	
40	3.58	9.00	86	5800.0	27	33	
41	3.58	9.00	101	5800.0	24	28	
42	3.58	9.10	100	5500.0	25	31	
44	3.11	9.60	70	5400.0	38	43	
45	3.11	9.60	70	5400.0	38	43	
46	3.23	9.20	90	5000.0	24	29	
61	3.39	8.60	84	4800.0	26	32	
62	3.39	8.60	84	4800.0	26	32	
64	3.39	8.60	84	4800.0	26	32	
80	3.46	7.50	116	5500.0	23	30	
82	3.86	7.00	145	5000.0	19	24	
100	3.47	8.50	97	5200.0	27	34	

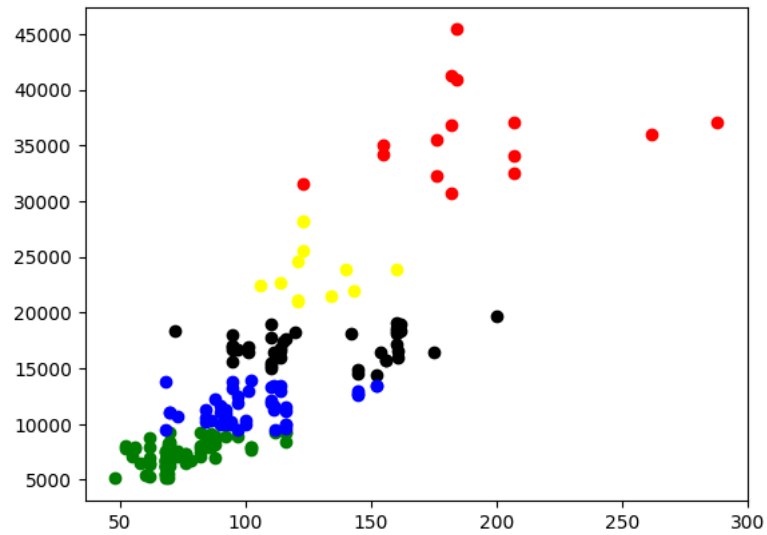
101	3.27	9.00	152	5200.0	17	22
103	3.27	9.00	152	5200.0	19	25
107	3.19	8.40	97	5000.0	19	24
108	3.52	21.00	95	4150.0	28	33
109	3.19	8.40	97	5000.0	19	24
110	3.52	21.00	95	4150.0	25	25
124	3.86	7.00	145	5000.0	19	24
132	3.07	9.31	110	5250.0	21	28
133	3.07	9.30	110	5250.0	21	28
143	2.64	9.00	94	5200.0	26	32
145	2.64	7.70	111	4800.0	24	29
147	2.64	9.00	94	5200.0	25	31
149	2.64	7.70	111	4800.0	23	23
166	3.08	9.40	112	6600.0	26	29
168	3.50	9.30	116	4800.0	24	30
169	3.50	9.30	116	4800.0	24	30
170	3.50	9.30	116	4800.0	24	30
171	3.50	9.30	116	4800.0	24	30
174	3.35	22.50	73	4500.0	30	33
175	3.54	8.70	92	4200.0	27	32
176	3.54	8.70	92	4200.0	27	32
177	3.54	8.70	92	4200.0	27	32
187	3.40	23.00	68	4500.0	37	42
188	3.40	10.00	100	5500.0	26	32
189	3.40	8.50	90	5500.0	24	29
190	3.40	8.50	90	5500.0	24	29
191	3.40	8.50	110	5500.0	19	24
192	3.40	23.00	68	4500.0	33	38
193	3.40	9.00	88	5500.0	25	31
194	3.15	9.50	114	5400.0	23	28
195	3.15	9.50	114	5400.0	23	28

	price	Cluster
0	13495	3
3	13950	3
29	12964	3
40	10295	3
41	12945	3
42	10345	3
44	11048	3
45	11048	3
46	11048	3
61	10595	3
62	10245	3
64	11245	3
80	9959	3
82	12629	3
100	9549	3
101	13499	3
103	13499	3
107	11900	3
108	13200	3
109	12440	3
110	13860	3
124	12764	3
132	11850	3
133	12170	3
143	9960	3
145	11259	3
147	10198	3
149	11694	3
166	9538	3
168	9639	3
169	9989	3
170	11199	3
171	11549	3
174	10698	3
175	9988	3
176	10898	3
177	11248	3
187	9495	3
188	9995	3
189	11595	3
190	9980	3
191	13295	3
192	13845	3
193	12290	3
194	12940	3
195	13415	3

[46 rows x 26 columns]

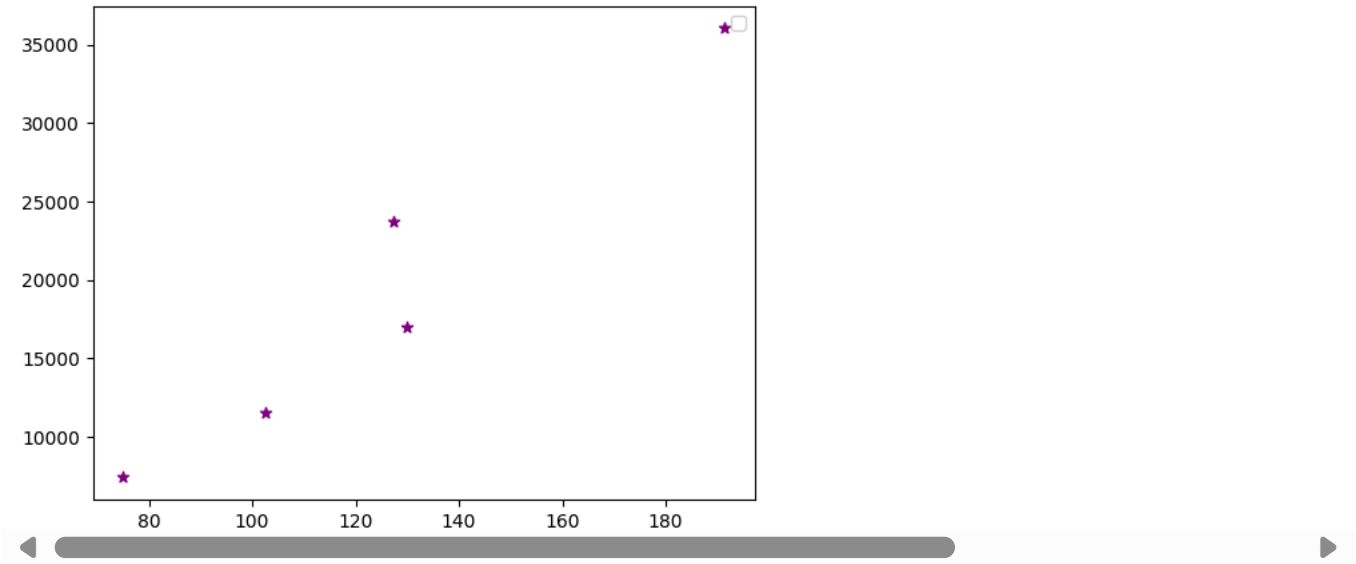
	Class	Make	Fuel_type	Aspiration	Num_doors	body_style
8	1	audi	gas	turbo	four	sedan
9	0	audi	gas	turbo	two	hatchback
12	0	bmw	gas	std	two	sedan
13	0	bmw	gas	std	four	sedan
14	1	bmw	gas	std	four	sedan
67	-1	mercedes-benz	diesel	turbo	four	sedan
68	-1	mercedes-benz	diesel	turbo	four	wagon
69	0	mercedes-benz	diesel	turbo	two	hardtop
125	3	porsche	gas	std	two	hatchback

```
125      -1       porsche       gas       std       two  hatchback
202      -1         volvo       gas       std      four      sedan
203      -1         volvo    diesel     turbo      four      sedan
204      -1         volvo       gas     turbo      four      sedan

    drive_wheels engine_location  wheel_base  length  ...  fuel_system  bore  \
8            fwd           front       105.8   192.7  ...         mpfi  3.13
9            4wd           front        99.5   178.2  ...         mpfi  3.13
12           rwd           front       101.2   176.8  ...         mpfi  3.31
13           rwd           front       101.2   176.8  ...         mpfi  3.31
14           rwd           front       103.5   189.0  ...         mpfi  3.31
67           rwd           front       110.0   190.9  ...          idi  3.58
68           rwd           front       110.0   190.9  ...          idi  3.58
69           rwd           front       106.7   187.5  ...          idi  3.58
125          rwd           front        94.5   168.9  ...         mpfi  3.94
202          rwd           front       109.1   188.8  ...         mpfi  3.58
203          rwd           front       109.1   188.8  ...          idi  3.01
204          rwd           front       109.1   188.8  ...         mpfi  3.78

     stroke compression _ratio horsepower  peal_rpm city_mpg  highway_mpg  \
8      3.40                8.3        140    5500.0       17           20
9      3.40                7.0        160    5500.0       16           22
12     3.19                9.0        121    4250.0       21           28
13     3.19                9.0        121    4250.0       21           28
14     3.19                9.0        121    4250.0       20           25
67     3.64               21.5        123    4350.0       22           25
68     3.64               21.5        123    4350.0       22           25
69     3.64               21.5        123    4350.0       22           25
125    3.11                9.5        143    5500.0       19           27
202    2.87                8.8        134    5500.0       18           23
203    3.40               23.0        106    4800.0       26           27
204    3.15                9.5        114    5400.0       19           25

     price  Cluster
8    23875        4
9    23875        4
12   20970        4
13   21105        4
14   24565        4
67   25552        4
68   28248        4
69   28176        4
125  22018        4
202  21485        4
203  22470        4
204  22625        4

[12 rows x 26 columns]
```



```
print(km.cluster_centers_)
print(km.algorithm)
plt.scatter(km.cluster_centers_[:,0],km.cluster_centers_[:,1],color='purple', marker="*")
plt.legend()
plt.show()
```

```
WARNING:matplotlib.legend:No artists with labels found to put in legend.  Note that artists whose label start with an underscore are
[[   75.          7395.74117647]
 [  191.33333333 36037.8       ]
 [  130.02564103 16963.87179487]
 [  102.5        11548.89130435]
 [  127.41666667 23747.        ]]
lloyd
```



Business Insights-

1. Customer Segmentation: Cluster 0: Customers interested in high-end, luxury cars. Cluster 1,2,3: Budget-conscious customers looking for affordable and efficient cars. Cluster 4: Customers preferring mid-range cars with balanced features.
2. Product Development: Focus on developing new models catering to the specific needs of each cluster. High-end features for Cluster 0, economical and efficient features for Cluster 1,2,3, and balanced features for Cluster 4.

```
print("CLUSTER SUMMARY")
cluster_summary = df.groupby("Cluster").agg(["count", "min", "max"])
print(cluster_summary)
```

```
CLUSTER SUMMARY
        Class          Make                          Fuel_type              \
        count min max count          min         max     count     min  max
Cluster
0          85  -1   3    85    chevrolet  volkswagen        85  diesel  gas
1          15  -1   3    15          bmw     porsche        15  diesel  gas
2          39  -2   3    39  alfa-romero       volvo        39  diesel  gas
3          46  -2   3    46  alfa-romero       volvo        46  diesel  gas
4          12  -1   3    12         audi       volvo        12  diesel  gas

        Aspiration  ... peal_rpm city_mpg         highway_mpg         price  \
             count  ...      max    count min max       count min max count
Cluster             ...
0               85  ...   6600.0       85  23  49          85  25  54    85
1               15  ...   5900.0       15  13  22          15  16  28    15
2               39  ...   5800.0       39  17  31          39  22  39    39
3               46  ...   6600.0       46  17  38          46  22  43    46
4               12  ...   5500.0       12  16  26          12  20  28    12


           min    max
Cluster
0         5118   9298
1        30760  45400
2        14399  19699
3         9495  13950
```