sqccq0nho

February 10, 2025

[1]:
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
```

[2]:
```
df = pd.read_csv(r"C:\Users\Omkar Gadade\Downloads\Imarticus Excel\␣
↪Python\ML\extended_data.csv")
df.head()
```

[2]:

	model_year	brand	model	type	miles_per_gallon	premium_version	msrp	collection_car
0	2016	Toyota	Land Cruiser Base	SUV	13.0	1	84900.0	0
1	2014	RAM	ProMaster 2500 Window Van High Roof	Van	15.0	0	35000.0	0
2	2002	Ford	Mustang GT	Coupe	16.0	0	26250.0	0
3	2012	BMW	428 Gran Coupe i xDrive	Sedan	27.0	1	45000.0	0
4	2008	Mercedes-Benz	SL-Class SL500 Roadster	Convertible	18.0	1	100000.0	1

[3]:
```
df.shape
```

[3]:
```
(28143, 8)
```

[4]:
```
df.isnull().sum()
```

[4]:
```
model_year           0
brand                0
model                0
type                 0
miles_per_gallon    17
premium_version      0
msrp                17
collection_car       0
```

```
dtype: int64
```

[5]:
```
df.dropna(subset=['miles_per_gallon', 'msrp'], axis=0, inplace=True)
```

[6]:
```
df.reset_index(inplace=True)
```

[7]:
```
df.isnull().sum()/df.shape[0]*100
```

[7]:
```
index               0.0
model_year          0.0
brand               0.0
model               0.0
type                0.0
miles_per_gallon    0.0
premium_version     0.0
msrp                0.0
collection_car      0.0
dtype: float64
```

[8]:
```
df["brand"].value_counts()[1]
```

[8]:
```
1949
```

[9]:
```
df[df.duplicated]
```

[9]:
```
Empty DataFrame
Columns: [index, model_year, brand, model, type, miles_per_gallon,
premium_version, msrp, collection_car]
Index: []
```

[10]:
```
df[['msrp']]
```

[10]:
```
           msrp
0       84900.0
1       35000.0
2       26250.0
3       45000.0
4      100000.0
…           …
28121  200000.0
28122   25000.0
28123  199000.0
28124   63700.0
28125   83500.0

[28126 rows x 1 columns]
```

[11]:
```
cat = []
num = []

for i in df.columns:
    if df[i].nunique()<=10:
        cat.append(i)
    else:
        num.append(i)
```

[12]:
```
cat
```

[12]:
```
['type', 'premium_version', 'collection_car']
```

[13]:
```
num
```

[13]:
```
['index', 'model_year', 'brand', 'model', 'miles_per_gallon', 'msrp']
```

[14]:
```
df.nunique()
```

[14]:
```
index              28126
model_year            36
brand                 57
model               1898
type                   9
miles_per_gallon     121
premium_version        2
msrp                2950
collection_car         2
dtype: int64
```

[15]:
```
df
```

[15]:
```
       index  model_year          brand  \
0          0        2016         Toyota
1          1        2014            RAM
2          2        2002           Ford
3          3        2012            BMW
4          4        2008  Mercedes-Benz
…      …          …              …
28121  28138        2017        Bentley
28122  28139        2001          Mazda
28123  28140        2018           Ford
28124  28141        2022           Land
28125  28142        2020           Audi

                                        model         type  \
0                          Land Cruiser Base          SUV
```

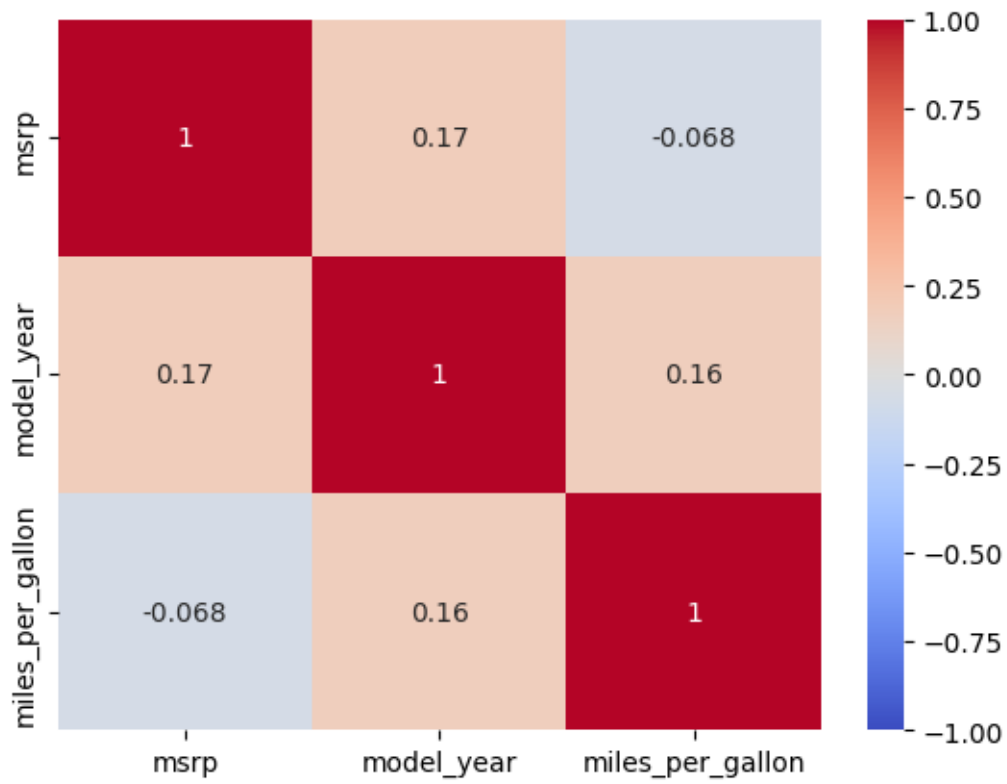
```
1            ProMaster 2500 Window Van High Roof          Van
2                                  Mustang GT        Coupe
3                      428 Gran Coupe i xDrive        Sedan
4                      SL-Class SL500 Roadster  Convertible
…                                        …          …
28121                        Huracan LP580-2S        Coupe
28122                              RX-8 Sport        Coupe
28123                           Model X P100D          SUV
28124  Rover Range Rover Velar P380 SE R-Dynamic          SUV
28125                        A7 3.0T Prestige        Sedan

       miles_per_gallon  premium_version      msrp  collection_car
0                  13.0                1   84900.0               0
1                  15.0                0   35000.0               0
2                  16.0                0   26250.0               0
3                  27.0                1   45000.0               0
4                  18.0                1  100000.0               1
…                     …                …         …             …
28121              21.0                1  200000.0               1
28122              18.0                0   25000.0               0
28123              94.0                1  199000.0               1
28124              20.0                1   63700.0               0
28125              22.0                1   83500.0               0

[28126 rows x 9 columns]
```

[16]:
```
corr_df = df[['msrp', 'model_year', 'miles_per_gallon']].corr()
sns.heatmap(corr_df, vmin= -1.0, annot=True, cmap='coolwarm')
```

[16]: <Axes: >



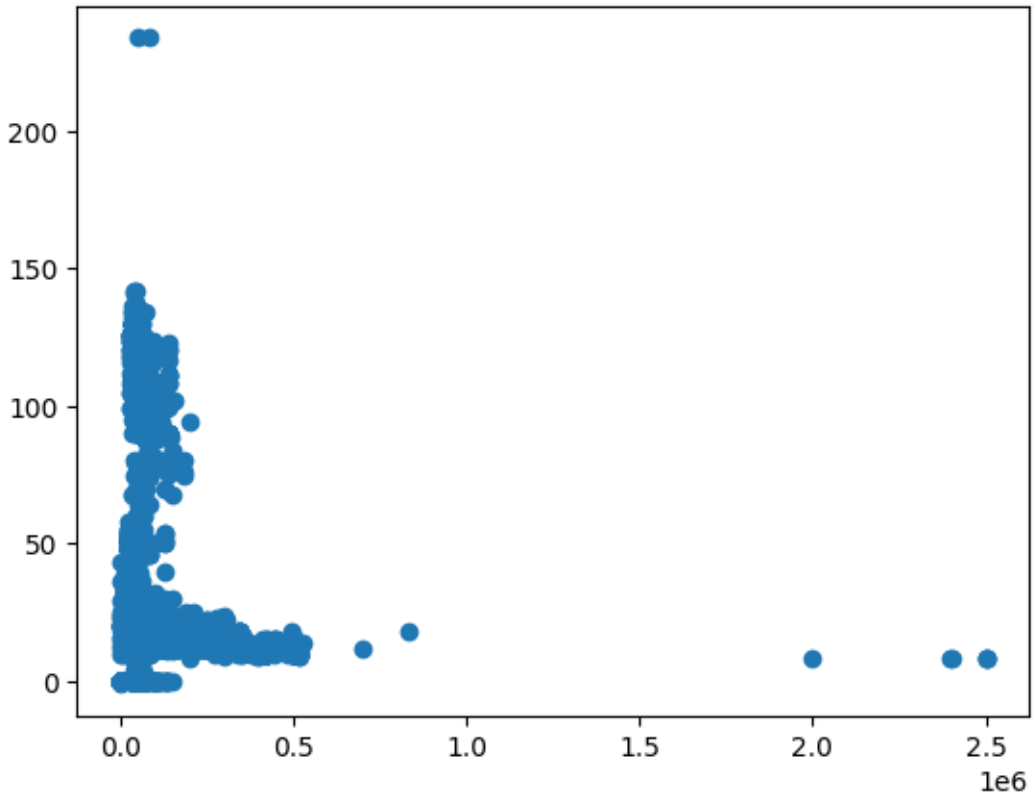
[17]:
```
df[['msrp','model_year','miles_per_gallon']].corr()
```

[17]:

	msrp	model_year	miles_per_gallon
msrp	1.000000	0.173006	-0.068152
model_year	0.173006	1.000000	0.164104
miles_per_gallon	-0.068152	0.164104	1.000000

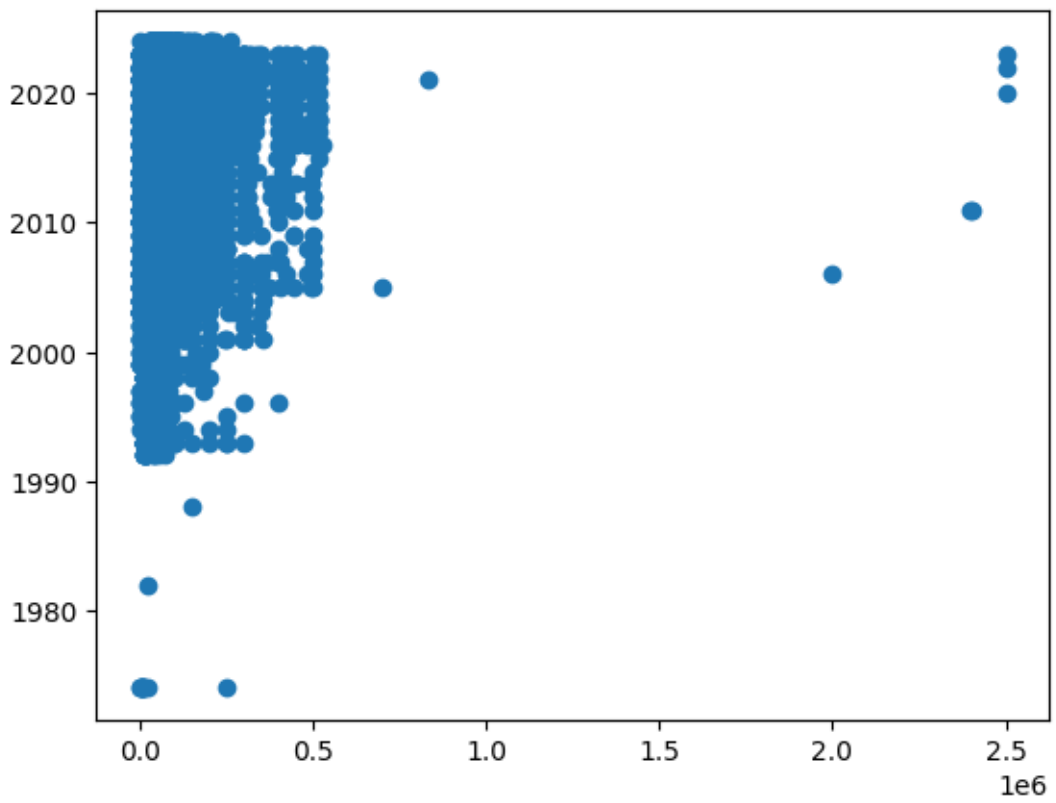
[18]:
```
plt.scatter(df['msrp'], df['miles_per_gallon'])
```

[18]:
```
<matplotlib.collections.PathCollection at 0x27feb1beb50>
```



[19]:
```
plt.scatter(df['msrp'], df['model_year'])
```

[19]: <matplotlib.collections.PathCollection at 0x27feb07fe50>



[20]:
```
df.drop('model', axis=1, inplace=True)
```

[21]:
```
df.head()
```

[21]:

	index	model_year	brand	type	miles_per_gallon	premium_version	msrp	collection_car
0	0	2016	Toyota	SUV	13.0	1	84900.0	0
1	1	2014	RAM	Van	15.0	0	35000.0	0
2	2	2002	Ford	Coupe	16.0	0	26250.0	0
3	3	2012	BMW	Sedan	27.0	1	45000.0	0
4	4	2008	Mercedes-Benz	Convertible	18.0	1	100000.0	1

[22]:
```
df.tail()
```

[22]:
```
       index  model_year    brand   type  miles_per_gallon  premium_version  \
28121  28138        2017  Bentley  Coupe              21.0                1
28122  28139        2001    Mazda  Coupe              18.0                0
28123  28140        2018     Ford    SUV              94.0                1
28124  28141        2022     Land    SUV              20.0                1
28125  28142        2020     Audi  Sedan              22.0                1

           msrp  collection_car
28121  200000.0               1
28122   25000.0               0
28123  199000.0               1
28124   63700.0               0
28125   83500.0               0
```

[23]:
```
#!pip install category_encoders; do it on brand columns as it has around 57 unique categories wrt msrp
```

[24]:
```
#import category_encoders as ce
```

[25]:
```
#for now doing One_Hot_Encoding
```

[26]:
```
from sklearn.preprocessing import OneHotEncoder
```

[27]:
```
Ohe = OneHotEncoder(sparse_output=False)
```

[28]:
```
Type = Ohe.fit_transform(df[['type']])
```

[29]:
```
Type
```

[29]:
```
array([[0., 0., 0., …, 0., 0., 0.],
       [0., 0., 0., …, 0., 1., 0.],
       [0., 1., 0., …, 0., 0., 0.],
       …,
       [0., 0., 0., …, 0., 0., 0.],
       [0., 0., 0., …, 0., 0., 0.],
       [0., 0., 0., …, 1., 0., 0.]])
```

[30]:
```
Type_df = pd.DataFrame(Type, columns=Ohe.categories_)
```

[31]:
```
Type_df
```

[31]:
```
       Convertible  Coupe  Hatchback  Minivan  Pickup  SUV  Sedan  Van  Wagon
0              0.0    0.0        0.0      0.0     0.0  1.0    0.0  0.0    0.0
1              0.0    0.0        0.0      0.0     0.0  0.0    0.0  1.0    0.0
2              0.0    1.0        0.0      0.0     0.0  0.0    0.0  0.0    0.0
3              0.0    0.0        0.0      0.0     0.0  0.0    1.0  0.0    0.0
4              1.0    0.0        0.0      0.0     0.0  0.0    0.0  0.0    0.0
```

```
…          …   …       …      …    …  …   …  …   …
28121        0.0   1.0       0.0      0.0    0.0  0.0   0.0  0.0   0.0
28122        0.0   1.0       0.0      0.0    0.0  0.0   0.0  0.0   0.0
28123        0.0   0.0       0.0      0.0    0.0  1.0   0.0  0.0   0.0
28124        0.0   0.0       0.0      0.0    0.0  1.0   0.0  0.0   0.0
28125        0.0   0.0       0.0      0.0    0.0  0.0   1.0  0.0   0.0

[28126 rows x 9 columns]
```

[32]:
```
Brands = Ohe.fit_transform(df[['brand']])
```

[33]:
```
Brands
```

[33]:
```
array([[0., 0., 0., …, 0., 0., 0.],
       [0., 0., 0., …, 0., 0., 0.],
       [0., 0., 0., …, 0., 0., 0.],
       …,
       [0., 0., 0., …, 0., 0., 0.],
       [0., 0., 0., …, 0., 0., 0.],
       [0., 0., 0., …, 0., 0., 0.]])
```

[34]:
```
Brands_df = pd.DataFrame(Brands, columns=Ohe.categories_)
```

[35]:
```
Brands_df
```

[35]:

	Acura	Alfa	Aston	Audi	BMW	Bentley	Bugatti	Buick	Cadillac	Chevrolet	…	Saab	Saturn	Scion	Subaru	Suzuki	Tesla	Toyota	Volkswagen	Volvo	smart
0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	…	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	…	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	…	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	…	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	…	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…
28121	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	…	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
28122	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	…	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
28123	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	…	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
28124	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	…	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
28125	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	…	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

```
28123  …  0.0    0.0   0.0    0.0    0.0   0.0    0.0        0.0   0.0   0.0
28124  …  0.0    0.0   0.0    0.0    0.0   0.0    0.0        0.0   0.0   0.0
28125  …  0.0    0.0   0.0    0.0    0.0   0.0    0.0        0.0   0.0   0.0

[28126 rows x 57 columns]
```

[36]:
```
df
```

[36]:
```
       index  model_year          brand         type  miles_per_gallon  \
0          0        2016         Toyota          SUV              13.0
1          1        2014            RAM          Van              15.0
2          2        2002           Ford        Coupe              16.0
3          3        2012            BMW        Sedan              27.0
4          4        2008  Mercedes-Benz  Convertible              18.0
…        …          …             …           …                 …
28121  28138        2017        Bentley        Coupe              21.0
28122  28139        2001          Mazda        Coupe              18.0
28123  28140        2018           Ford          SUV              94.0
28124  28141        2022           Land          SUV              20.0
28125  28142        2020           Audi        Sedan              22.0

       premium_version      msrp  collection_car
0                    1   84900.0               0
1                    0   35000.0               0
2                    0   26250.0               0
3                    1   45000.0               0
4                    1  100000.0               1
…                  …        …              …
28121                1  200000.0               1
28122                0   25000.0               0
28123                1  199000.0               1
28124                1   63700.0               0
28125                1   83500.0               0

[28126 rows x 8 columns]
```

[37]:
```
df = pd.concat([df, Type_df, Brands_df], axis=1)
```

[38]:
```
df.head()
```

[38]:
```
   index  model_year          brand         type  miles_per_gallon  \
0      0        2016         Toyota          SUV              13.0
1      1        2014            RAM          Van              15.0
2      2        2002           Ford        Coupe              16.0
3      3        2012            BMW        Sedan              27.0
4      4        2008  Mercedes-Benz  Convertible              18.0
```

```
   premium_version      msrp  collection_car  (Convertible,)  (Coupe,)  …  \
0                1   84900.0               0             0.0       0.0  …
1                0   35000.0               0             0.0       0.0  …
2                0   26250.0               0             0.0       1.0  …
3                1   45000.0               0             0.0       0.0  …
4                1  100000.0               1             1.0       0.0  …

   (Saab,)  (Saturn,)  (Scion,)  (Subaru,)  (Suzuki,)  (Tesla,)  (Toyota,)  \
0      0.0        0.0       0.0        0.0        0.0       0.0        1.0
1      0.0        0.0       0.0        0.0        0.0       0.0        0.0
2      0.0        0.0       0.0        0.0        0.0       0.0        0.0
3      0.0        0.0       0.0        0.0        0.0       0.0        0.0
4      0.0        0.0       0.0        0.0        0.0       0.0        0.0

   (Volkswagen,)  (Volvo,)  (smart,)
0            0.0       0.0       0.0
1            0.0       0.0       0.0
2            0.0       0.0       0.0
3            0.0       0.0       0.0
4            0.0       0.0       0.0

[5 rows x 74 columns]
```

[39]:
```
df.tail()
```

[39]:
```
       index  model_year    brand   type  miles_per_gallon  premium_version  \
28121  28138        2017  Bentley  Coupe              21.0                1
28122  28139        2001    Mazda  Coupe              18.0                0
28123  28140        2018     Ford    SUV              94.0                1
28124  28141        2022     Land    SUV              20.0                1
28125  28142        2020     Audi  Sedan              22.0                1

           msrp  collection_car  (Convertible,)  (Coupe,)  …  (Saab,)  \
28121  200000.0               1             0.0       1.0  …      0.0
28122   25000.0               0             0.0       1.0  …      0.0
28123  199000.0               1             0.0       0.0  …      0.0
28124   63700.0               0             0.0       0.0  …      0.0
28125   83500.0               0             0.0       0.0  …      0.0

       (Saturn,)  (Scion,)  (Subaru,)  (Suzuki,)  (Tesla,)  (Toyota,)  \
28121        0.0       0.0        0.0        0.0       0.0        0.0
28122        0.0       0.0        0.0        0.0       0.0        0.0
28123        0.0       0.0        0.0        0.0       0.0        0.0
28124        0.0       0.0        0.0        0.0       0.0        0.0
28125        0.0       0.0        0.0        0.0       0.0        0.0

       (Volkswagen,)  (Volvo,)  (smart,)
```

```
28121            0.0       0.0       0.0
28122            0.0       0.0       0.0
28123            0.0       0.0       0.0
28124            0.0       0.0       0.0
28125            0.0       0.0       0.0

[5 rows x 74 columns]
```

[ ]:

[40]:
```
df.drop(['brand','type'], axis=1, inplace=True)
```

[41]:
```
df.head()
```

[41]:
```
   index  model_year  miles_per_gallon  premium_version      msrp  \
0      0        2016              13.0                1   84900.0
1      1        2014              15.0                0   35000.0
2      2        2002              16.0                0   26250.0
3      3        2012              27.0                1   45000.0
4      4        2008              18.0                1  100000.0

   collection_car  (Convertible,)  (Coupe,)  (Hatchback,)  (Minivan,)  …  \
0               0             0.0       0.0           0.0         0.0  …
1               0             0.0       0.0           0.0         0.0  …
2               0             0.0       1.0           0.0         0.0  …
3               0             0.0       0.0           0.0         0.0  …
4               1             1.0       0.0           0.0         0.0  …

   (Saab,)  (Saturn,)  (Scion,)  (Subaru,)  (Suzuki,)  (Tesla,)  (Toyota,)  \
0      0.0        0.0       0.0        0.0        0.0       0.0        1.0
1      0.0        0.0       0.0        0.0        0.0       0.0        0.0
2      0.0        0.0       0.0        0.0        0.0       0.0        0.0
3      0.0        0.0       0.0        0.0        0.0       0.0        0.0
4      0.0        0.0       0.0        0.0        0.0       0.0        0.0

   (Volkswagen,)  (Volvo,)  (smart,)
0            0.0       0.0       0.0
1            0.0       0.0       0.0
2            0.0       0.0       0.0
3            0.0       0.0       0.0
4            0.0       0.0       0.0

[5 rows x 72 columns]
```

[42]:
```
from sklearn.linear_model import LinearRegression
```

[43]:
```
lr_model = LinearRegression()
```

[44]:
```
df.columns
```

[44]:
```
Index([          'index',       'model_year', 'miles_per_gallon',
        'premium_version',             'msrp',   'collection_car',
         ('Convertible',),        ('Coupe',),     ('Hatchback',),
             ('Minivan',),       ('Pickup',),          ('SUV',),
               ('Sedan',),          ('Van',),        ('Wagon',),
               ('Acura',),         ('Alfa',),        ('Aston',),
                ('Audi',),          ('BMW',),      ('Bentley',),
             ('Bugatti',),        ('Buick',),      ('Cadillac',),
           ('Chevrolet',),      ('Chrysler',),         ('Dodge',),
                ('FIAT',),       ('Ferrari',),          ('Ford',),
                 ('GMC',),       ('Genesis',),         ('Honda',),
              ('Hummer',),       ('Hyundai',),      ('INFINITI',),
              ('Jaguar',),          ('Jeep',),         ('Karma',),
                 ('Kia',),   ('Lamborghini',),          ('Land',),
               ('Lexus',),       ('Lincoln',),         ('Lotus',),
               ('Lucid',),          ('MINI',),      ('Maserati',),
             ('Maybach',),         ('Mazda',),       ('McLaren',),
       ('Mercedes-Benz',),       ('Mercury',),    ('Mitsubishi',),
              ('Nissan',),      ('Plymouth',),      ('Polestar',),
             ('Pontiac',),       ('Porsche',),           ('RAM',),
              ('Rivian',),   ('Rolls-Royce',),          ('Saab',),
              ('Saturn',),         ('Scion',),        ('Subaru',),
              ('Suzuki',),         ('Tesla',),        ('Toyota',),
          ('Volkswagen',),         ('Volvo',),         ('smart',)],
      dtype='object')
```

[45]:
```
X_df = df.drop('msrp', axis=1)
X_df
```

[45]:

	index	model_year	miles_per_gallon	premium_version	collection_car	\
0	0	2016	13.0	1	0	
1	1	2014	15.0	0	0	
2	2	2002	16.0	0	0	
3	3	2012	27.0	1	0	
4	4	2008	18.0	1	1	
…	…	…	…	…	…	
28121	28138	2017	21.0	1	1	
28122	28139	2001	18.0	0	0	
28123	28140	2018	94.0	1	1	
28124	28141	2022	20.0	1	0	
28125	28142	2020	22.0	1	0	

	(Convertible,)	(Coupe,)	(Hatchback,)	(Minivan,)	(Pickup,)	…	\
0	0.0	0.0	0.0	0.0	0.0	…	
1	0.0	0.0	0.0	0.0	0.0	…	

```
2                0.0       1.0           0.0         0.0        0.0  …
3                0.0       0.0           0.0         0.0        0.0  …
4                1.0       0.0           0.0         0.0        0.0  …
…                …         …             …           …          …  …
28121            0.0       1.0           0.0         0.0        0.0  …
28122            0.0       1.0           0.0         0.0        0.0  …
28123            0.0       0.0           0.0         0.0        0.0  …
28124            0.0       0.0           0.0         0.0        0.0  …
28125            0.0       0.0           0.0         0.0        0.0  …

       (Saab,)  (Saturn,)  (Scion,)  (Subaru,)  (Suzuki,)  (Tesla,)  \
0          0.0        0.0       0.0        0.0        0.0       0.0
1          0.0        0.0       0.0        0.0        0.0       0.0
2          0.0        0.0       0.0        0.0        0.0       0.0
3          0.0        0.0       0.0        0.0        0.0       0.0
4          0.0        0.0       0.0        0.0        0.0       0.0
…          …          …         …          …          …         …
28121      0.0        0.0       0.0        0.0        0.0       0.0
28122      0.0        0.0       0.0        0.0        0.0       0.0
28123      0.0        0.0       0.0        0.0        0.0       0.0
28124      0.0        0.0       0.0        0.0        0.0       0.0
28125      0.0        0.0       0.0        0.0        0.0       0.0

       (Toyota,)  (Volkswagen,)  (Volvo,)  (smart,)
0            1.0            0.0       0.0       0.0
1            0.0            0.0       0.0       0.0
2            0.0            0.0       0.0       0.0
3            0.0            0.0       0.0       0.0
4            0.0            0.0       0.0       0.0
…            …              …         …         …
28121        0.0            0.0       0.0       0.0
28122        0.0            0.0       0.0       0.0
28123        0.0            0.0       0.0       0.0
28124        0.0            0.0       0.0       0.0
28125        0.0            0.0       0.0       0.0

[28126 rows x 71 columns]
```

[46]:
```
X = X_df.values
```

[47]:
```
X
```

[47]:
```
array([[0.0000e+00, 2.0160e+03, 1.3000e+01, …, 0.0000e+00, 0.0000e+00,
        0.0000e+00],
       [1.0000e+00, 2.0140e+03, 1.5000e+01, …, 0.0000e+00, 0.0000e+00,
        0.0000e+00],
       [2.0000e+00, 2.0020e+03, 1.6000e+01, …, 0.0000e+00, 0.0000e+00,
```

```
         0.0000e+00],
        …,
        [2.8140e+04, 2.0180e+03, 9.4000e+01, …, 0.0000e+00, 0.0000e+00,
         0.0000e+00],
        [2.8141e+04, 2.0220e+03, 2.0000e+01, …, 0.0000e+00, 0.0000e+00,
         0.0000e+00],
        [2.8142e+04, 2.0200e+03, 2.2000e+01, …, 0.0000e+00, 0.0000e+00,
         0.0000e+00]])
```

[48]:
```
df
```

[48]:

	index	model_year	miles_per_gallon	premium_version	msrp	\
0	0	2016	13.0	1	84900.0	
1	1	2014	15.0	0	35000.0	
2	2	2002	16.0	0	26250.0	
3	3	2012	27.0	1	45000.0	
4	4	2008	18.0	1	100000.0	
…	…	…	…	…	…	
28121	28138	2017	21.0	1	200000.0	
28122	28139	2001	18.0	0	25000.0	
28123	28140	2018	94.0	1	199000.0	
28124	28141	2022	20.0	1	63700.0	
28125	28142	2020	22.0	1	83500.0	

	collection_car	(Convertible,)	(Coupe,)	(Hatchback,)	(Minivan,)	\
0	0	0.0	0.0	0.0	0.0	
1	0	0.0	0.0	0.0	0.0	
2	0	0.0	1.0	0.0	0.0	
3	0	0.0	0.0	0.0	0.0	
4	1	1.0	0.0	0.0	0.0	
…	…	…	…	…	…	
28121	1	0.0	1.0	0.0	0.0	
28122	0	0.0	1.0	0.0	0.0	
28123	1	0.0	0.0	0.0	0.0	
28124	0	0.0	0.0	0.0	0.0	
28125	0	0.0	0.0	0.0	0.0	

	…	(Saab,)	(Saturn,)	(Scion,)	(Subaru,)	(Suzuki,)	(Tesla,)	\
0	…	0.0	0.0	0.0	0.0	0.0	0.0	
1	…	0.0	0.0	0.0	0.0	0.0	0.0	
2	…	0.0	0.0	0.0	0.0	0.0	0.0	
3	…	0.0	0.0	0.0	0.0	0.0	0.0	
4	…	0.0	0.0	0.0	0.0	0.0	0.0	
…	…	…	…	…	…	…	…	
28121	…	0.0	0.0	0.0	0.0	0.0	0.0	
28122	…	0.0	0.0	0.0	0.0	0.0	0.0	
28123	…	0.0	0.0	0.0	0.0	0.0	0.0	

```
28124  …      0.0        0.0       0.0        0.0        0.0       0.0
28125  …      0.0        0.0       0.0        0.0        0.0       0.0

       (Toyota,)  (Volkswagen,)  (Volvo,)  (smart,)
0            1.0            0.0       0.0       0.0
1            0.0            0.0       0.0       0.0
2            0.0            0.0       0.0       0.0
3            0.0            0.0       0.0       0.0
4            0.0            0.0       0.0       0.0
…            …              …         …         …
28121        0.0            0.0       0.0       0.0
28122        0.0            0.0       0.0       0.0
28123        0.0            0.0       0.0       0.0
28124        0.0            0.0       0.0       0.0
28125        0.0            0.0       0.0       0.0

[28126 rows x 72 columns]
```

[49]:
```
y_df = df['msrp']
y_df
```

[49]:
```
0         84900.0
1         35000.0
2         26250.0
3         45000.0
4        100000.0
           …
28121    200000.0
28122     25000.0
28123    199000.0
28124     63700.0
28125     83500.0
Name: msrp, Length: 28126, dtype: float64
```

[50]:
```
y= y_df.values
```

[51]:
```
y
```

[51]:
```
array([ 84900.,  35000.,  26250., …, 199000.,  63700.,  83500.])
```

[52]:
```
from sklearn.model_selection import train_test_split
```

[53]:
```
X_train, X_test, y_train, y_test = train_test_split(X,y,test_size=0.2,␣
 ↪random_state=0)
```

[54]:
```
X_train
```

[54]:
```
array([[1.5960e+04, 2.0090e+03, 2.0000e+01, …, 0.0000e+00, 0.0000e+00,
        0.0000e+00],
       [4.0560e+03, 2.0200e+03, 1.8000e+01, …, 0.0000e+00, 0.0000e+00,
        0.0000e+00],
       [1.0933e+04, 2.0220e+03, 1.5000e+01, …, 0.0000e+00, 0.0000e+00,
        0.0000e+00],
       …,
       [9.8500e+03, 2.0150e+03, 1.9000e+01, …, 0.0000e+00, 0.0000e+00,
        0.0000e+00],
       [1.0804e+04, 2.0090e+03, 2.1000e+01, …, 0.0000e+00, 0.0000e+00,
        0.0000e+00],
       [2.7320e+03, 2.0210e+03, 1.6000e+01, …, 0.0000e+00, 0.0000e+00,
        0.0000e+00]])
```

[55]:
```
y_train
```

[55]:
```
array([ 35000., 114000., 250000., …,  42900.,  65500.,  68000.])
```

[56]:
```
print(X_train.shape)
print(X_test.shape)
print(y_train.shape)
print(y_test.shape)
```

```
(22500, 71)
(5626, 71)
(22500,)
(5626,)
```

[57]:
```
from sklearn.linear_model import LinearRegression
```

[58]:
```
lr_model= LinearRegression()
```

[59]:
```
lr_model.fit(X_train, y_train)
```

[59]:
```
LinearRegression()
```

[60]:
```
y_train_predict = lr_model.predict(X_train)
```

[61]:
```
y_train_predict
```

[61]:
```
array([ 32722.50129031,  69365.996934  , 237883.87078627, …,
        60100.77178296,  36748.51624103,  55713.08070069])
```

[63]:
```
y_test_predict = lr_model.predict(X_test)
```

[64]:
```
y_test_predict
```

[64]:
```
array([ 96543.03929497,  90067.11399143,  51324.12415724, …,
       149187.25299338,  19813.26451702,  54249.02774183])
```

[65]:
```
from sklearn.metrics import mean_squared_error, mean_absolute_error
```

[67]:
```
mse_train=mean_squared_error(y_train_predict,y_train)
rmse_train= mean_squared_error(y_train_predict,y_train)**0.5
mae_train= mean_absolute_error(y_train_predict,y_train)

print(mse_train)
print(rmse_train)
print(mae_train)
```

```
1242536717.89819
35249.6342945312
16484.96275481593
```

[68]:
```
mse_test= mean_squared_error(y_test_predict, y_test)
rmse_test= mean_squared_error(y_test_predict, y_test)**0.5
mae_test= mean_absolute_error(y_test_predict, y_test)

print(mse_test)
print(rmse_test)
print(mae_test)
```

```
877221058.143512
29617.917856316504
16686.248850344826
```

[ ]: