Importing Libraries

In [46]:

```
import numpy as np
import pandas as pd
from pandas import DataFrame as df
import matplotlib.pyplot as plt
from scipy import stats
import scipy.stats as ss
import seaborn as sns
```

Loading file

In [2]:

```
filename = 'https://s3-api.us-geo.objectstorage.softlayer.net/cf-courses-data/
CognitiveClass/DA0101EN/automobileEDA.csv'
```

In [3]:

```
cars = pd.read_csv(filename)
```

In [4]:

```
cars
```

Out[4]:

	symboling	normalized-losses	make	aspiration	num-of-doors	body-style	drive-wheels	engine-location	whee bas
0	3	122	alfa-romero	std	two	convertible	rwd	front	88
1	3	122	alfa-romero	std	two	convertible	rwd	front	88
2	1	122	alfa-romero	std	two	hatchback	rwd	front	94
3	2	164	audi	std	four	sedan	fwd	front	99
4	2	164	audi	std	four	sedan	4wd	front	99
...	...	...	...	...	...	...	...	...	
196	-1	95	volvo	std	four	sedan	rwd	front	109
197	-1	95	volvo	turbo	four	sedan	rwd	front	109
198	-1	95	volvo	std	four	sedan	rwd	front	109
199	-1	95	volvo	turbo	four	sedan	rwd	front	109
200	-1	95	volvo	turbo	four	sedan	rwd	front	109

201 rows × 29 columns

Viewing DataTypes

In [5]:

```
print("Dimensions are:")
print(cars.shape)
print("")
print("Datatypes:")
print(cars.dtypes)
```

```
Dimensions are:
(201, 29)

Datatypes:
symboling              int64
normalized-losses      int64
make                  object
aspiration            object
num-of-doors          object
body-style            object
drive-wheels          object
engine-location       object
wheel-base           float64
length               float64
width                float64
height               float64
curb-weight            int64
engine-type           object
num-of-cylinders      object
engine-size            int64
fuel-system           object
bore                 float64
stroke               float64
compression-ratio    float64
horsepower           float64
peak-rpm             float64
city-mpg               int64
highway-mpg            int64
price                float64
city-L/100km         float64
horsepower-binned     object
diesel                 int64
gas                    int64
dtype: object
```

Viewing correlation between variables 'price' and 'engine-size'

In [6]:

```
correlation = cars.corr()
correlation['price']['engine-size']
```

Out[6]:

```
0.8723351674455199
```

Checking for negative or positive correlation of variables with respect to price

In [7]:

```
for i in cars.describe().columns:
    a = correlation['price'][i]
    if (a > 0 or a < 0):
        sign = "Positive"
        if (a < 0):
            sign = "Negative"
        else:
            sign = "Positive"
        print("Column name: {gog:s}      Correlation: {fog:s}".format(gog = i,
fog = sign))
```

```
Column name: symboling      Correlation: Negative
Column name: normalized-losses      Correlation: Positive
Column name: wheel-base      Correlation: Positive
Column name: length      Correlation: Positive
Column name: width      Correlation: Positive
Column name: height      Correlation: Positive
Column name: curb-weight      Correlation: Positive
Column name: engine-size      Correlation: Positive
Column name: bore      Correlation: Positive
Column name: stroke      Correlation: Positive
Column name: compression-ratio      Correlation: Positive
Column name: horsepower      Correlation: Positive
Column name: peak-rpm      Correlation: Negative
Column name: city-mpg      Correlation: Negative
Column name: highway-mpg      Correlation: Negative
Column name: price      Correlation: Positive
Column name: city-L/100km      Correlation: Positive
Column name: diesel      Correlation: Positive
Column name: gas      Correlation: Negative
```

Checking datatype of variable 'peak-rpm'

In [8]:

```
type(cars['peak-rpm'][1])
```

Out[8]:

```
numpy.float64
```

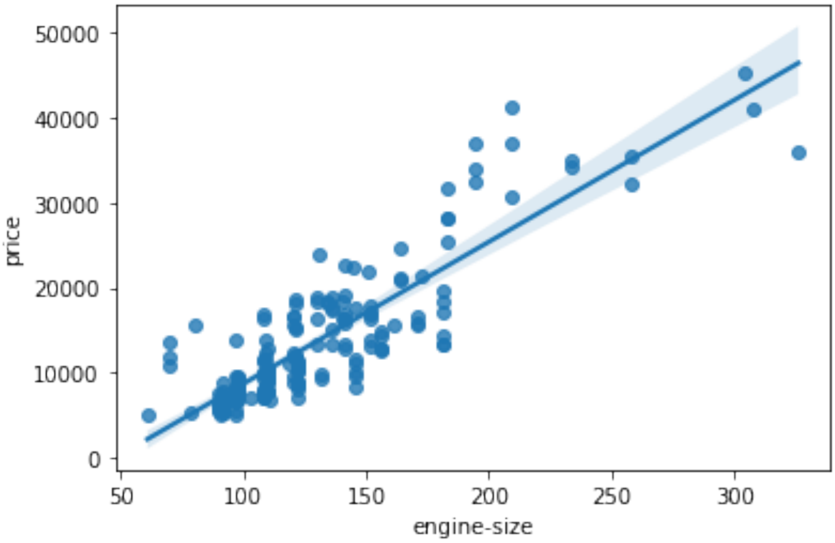
Using seaborn regplot() - plot relation between “engine-size” and “price”.

In [9]:

```
sns.regplot('engine-size', 'price', data=cars)
```

Out[9]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x7fed7f511c50>
```



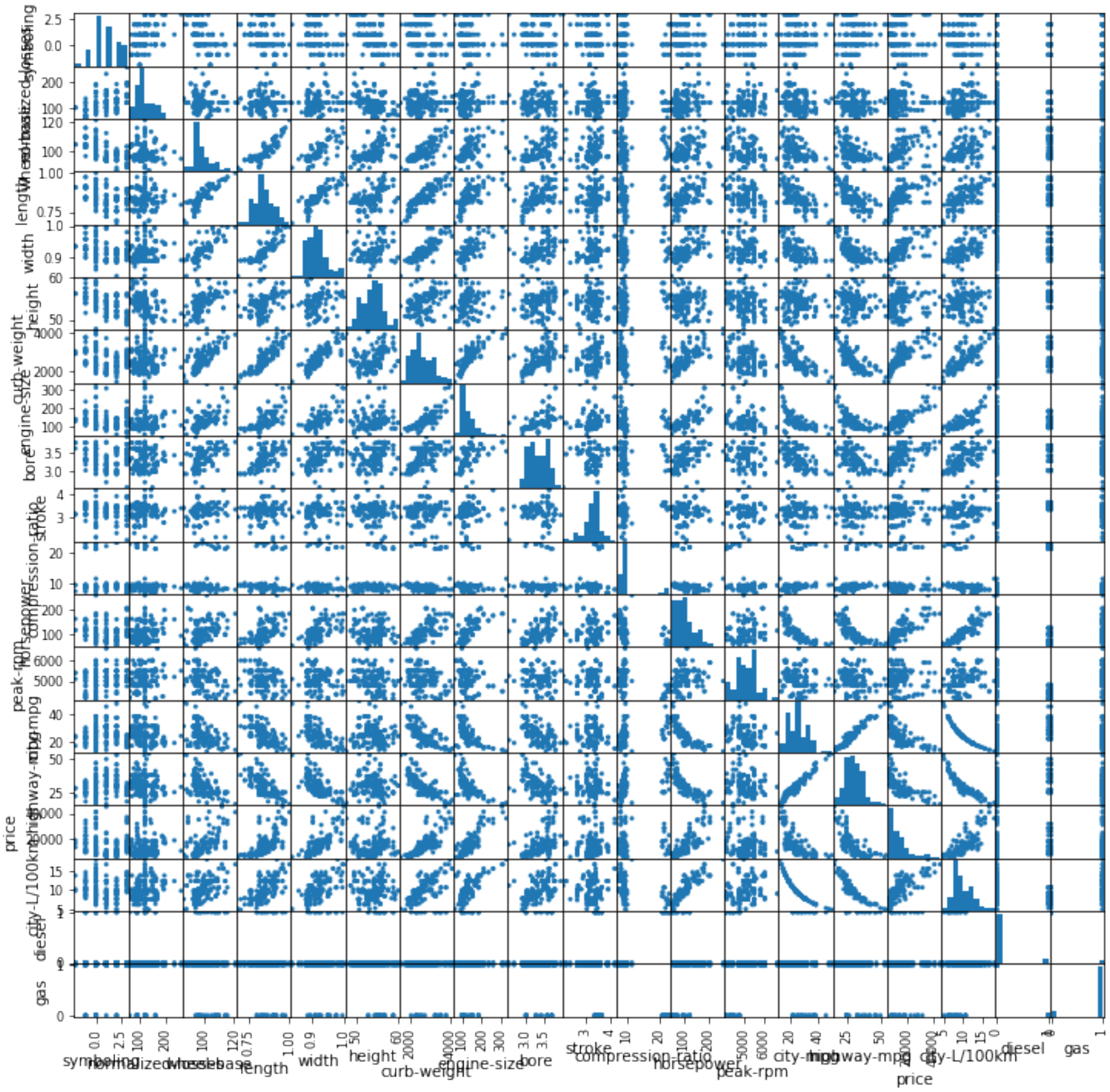
Engine size and price are positively correlated.Checking pandas scatter_matrix

In [12]:

```
from pandas.plotting import scatter_matrix
```

In [18]:

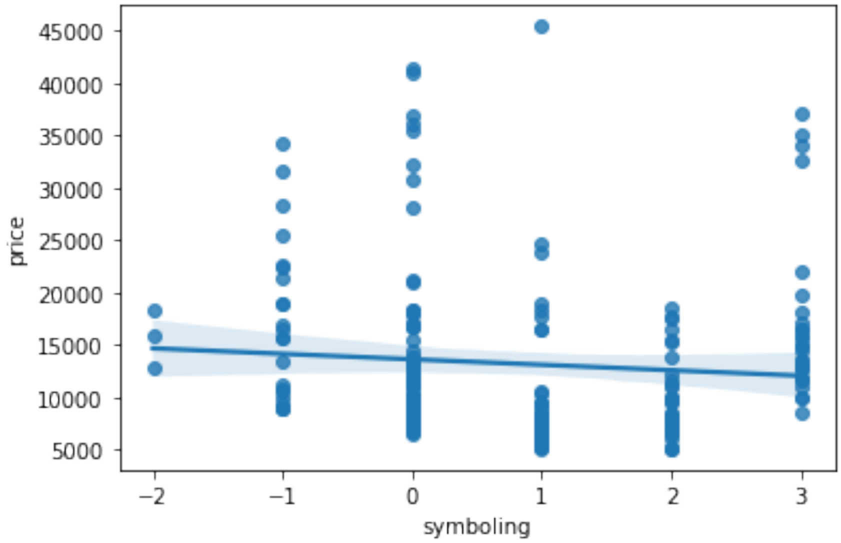
```
scatter_matrix(cars, alpha = 1, figsize = (12,12));
```

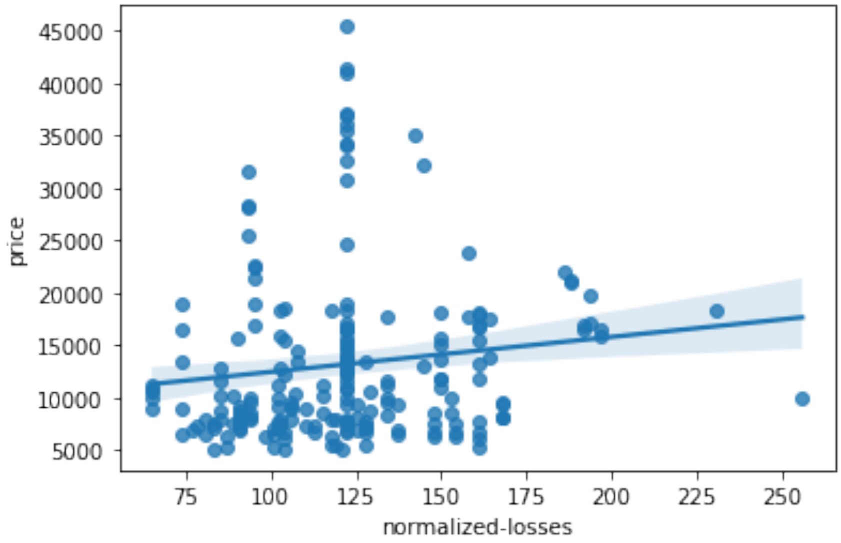


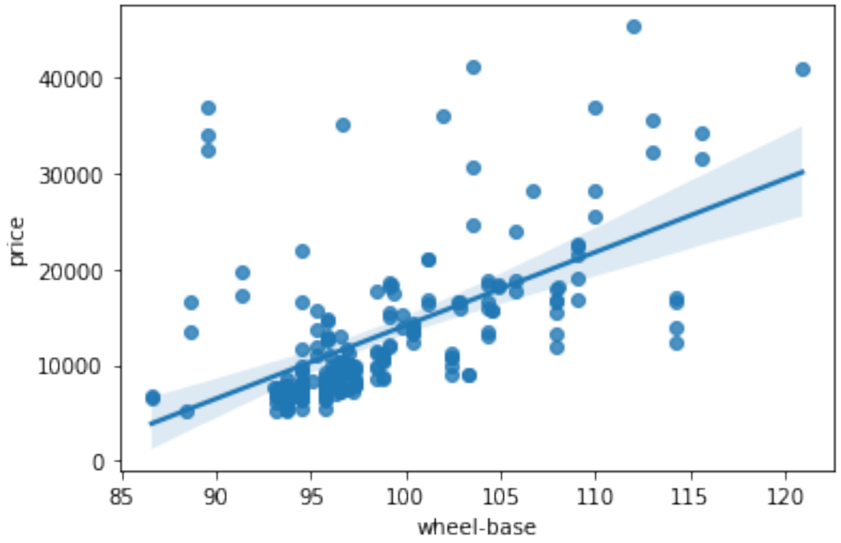
Viewing individual - variable Regplot

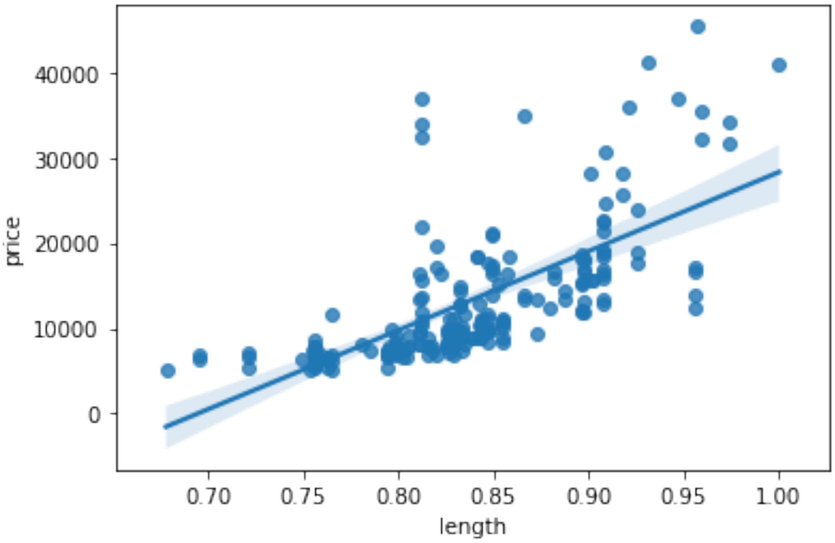
In [19]:

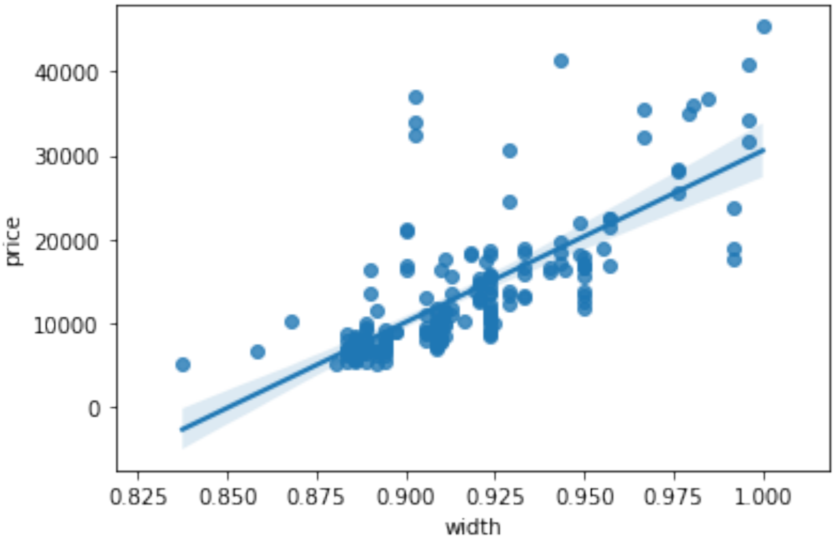
```
for i in cars.describe().columns:
    if i!='price':
        sns.regplot(y='price', x=i, data = cars)
        plt.show()
```

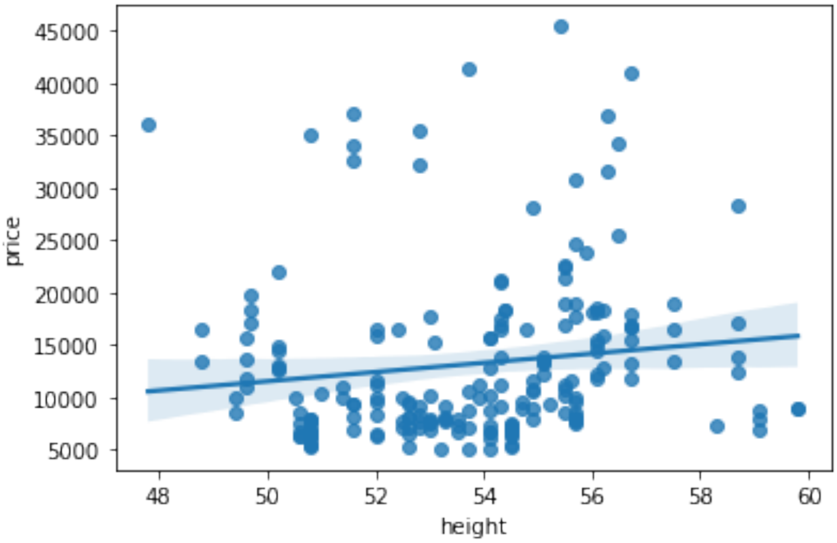

price
45000
40000
35000
30000
25000
20000
15000
10000
5000
−2
−1
0
1
2
3
symboling

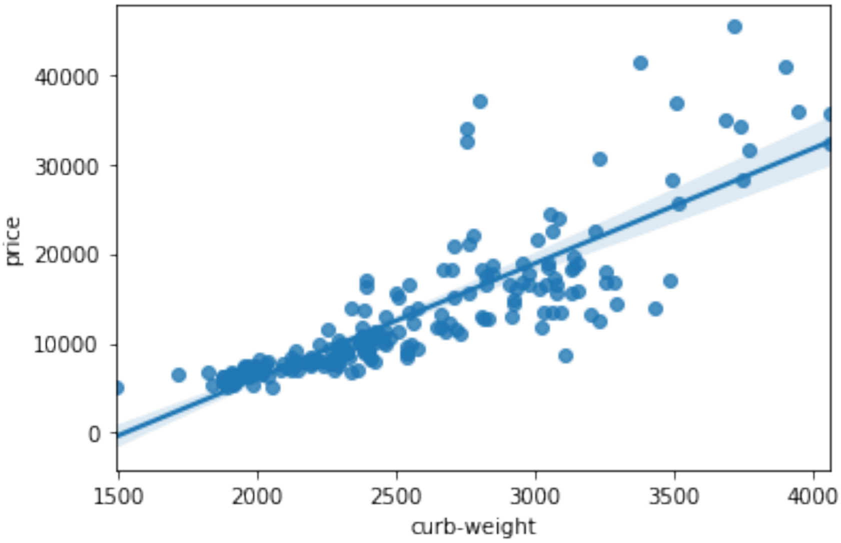

price
45000
40000
35000
30000
25000
20000
15000
10000
5000
75
100
125
150
175
200
225
250
normalized-losses

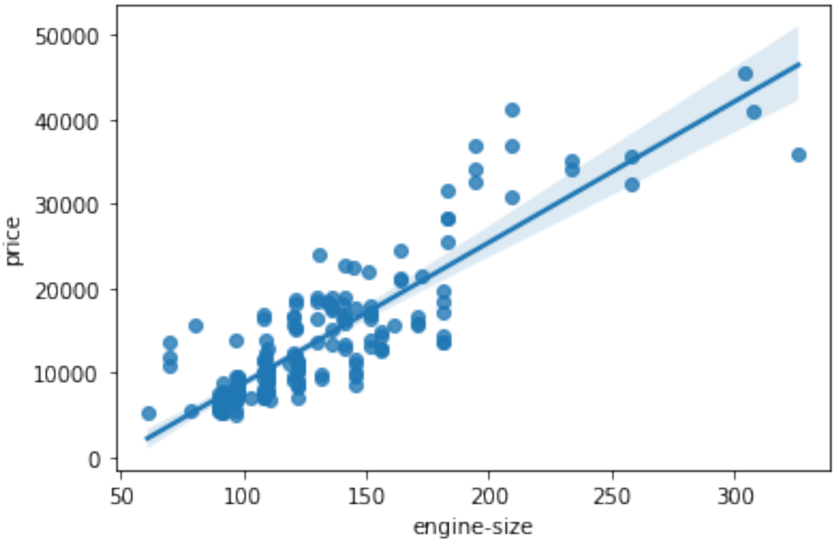

price
40000
30000
20000
10000
0
85
90
95
100
105
110
115
120
wheel-base

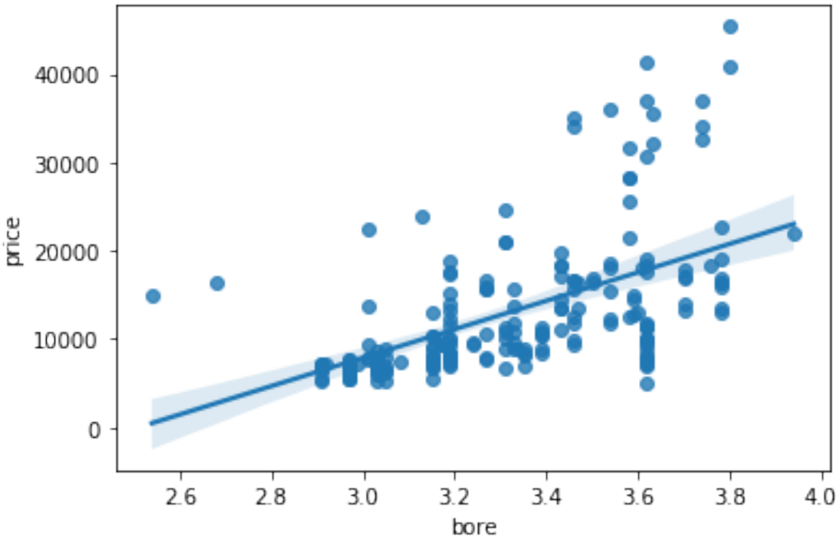

price
40000
30000
20000
10000
0
0.70
0.75
0.80
0.85
0.90
0.95
1.00
length

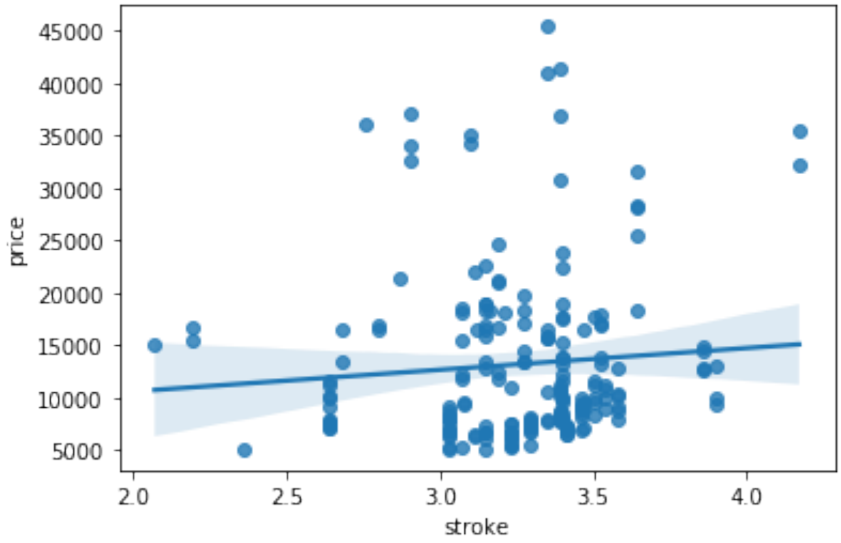

price
40000
30000
20000
10000
0
0.825
0.850
0.875
0.900
0.925
0.950
0.975
1.000
width

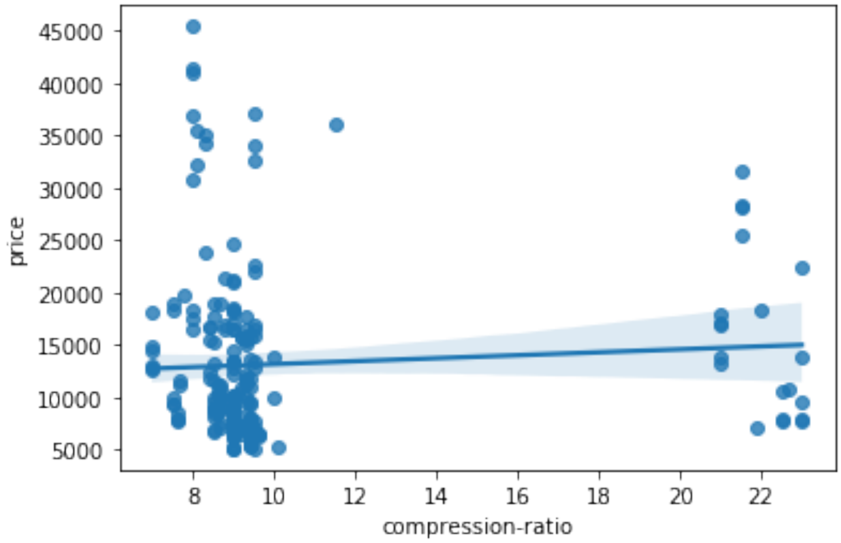

price
45000
40000
35000
30000
25000
20000
15000
10000
5000
48
50
52
54
56
58
60
height

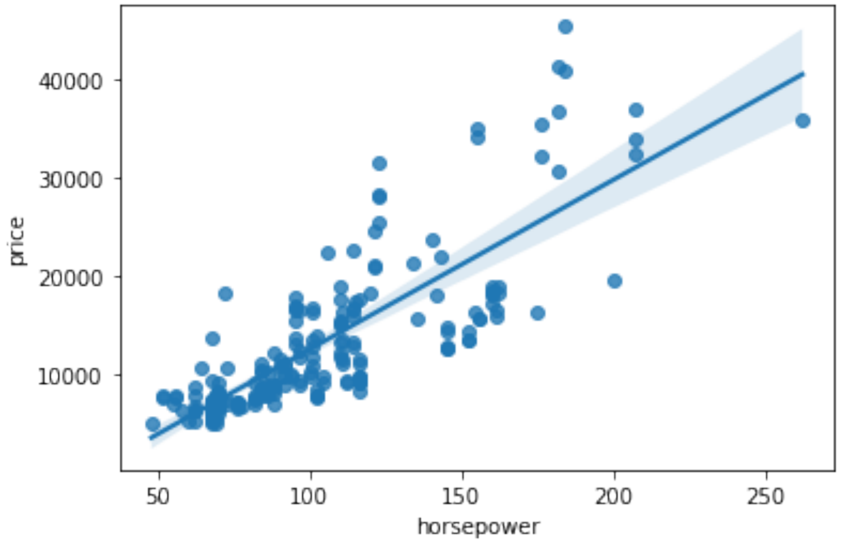

price
0
10000
20000
30000
40000
1500
2000
2500
3000
3500
4000
curb-weight

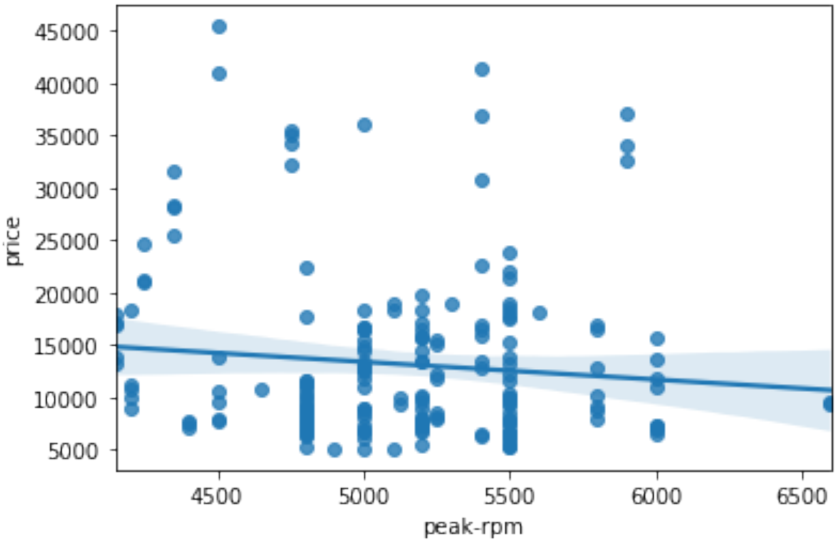

price
0
10000
20000
30000
40000
50000
50
100
150
200
250
300
engine-size

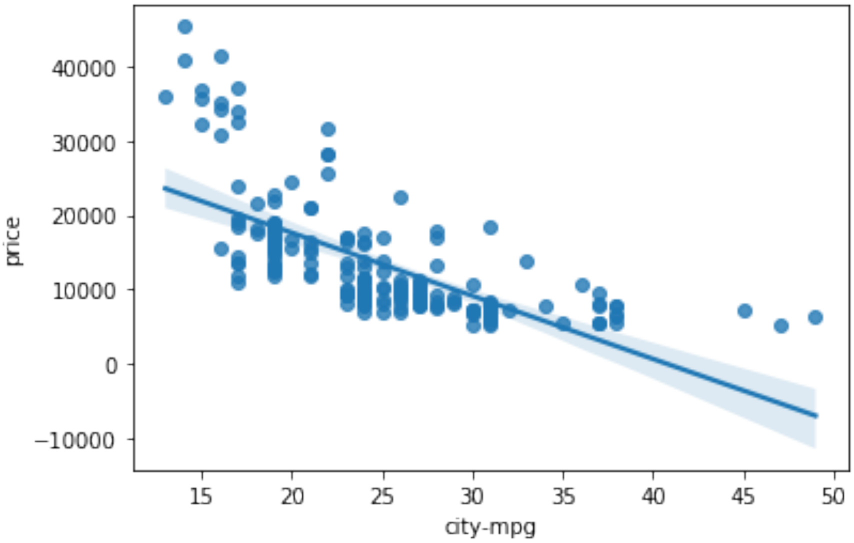

price
0
10000
20000
30000
40000
2.6
2.8
3.0
3.2
3.4
3.6
3.8
4.0
bore

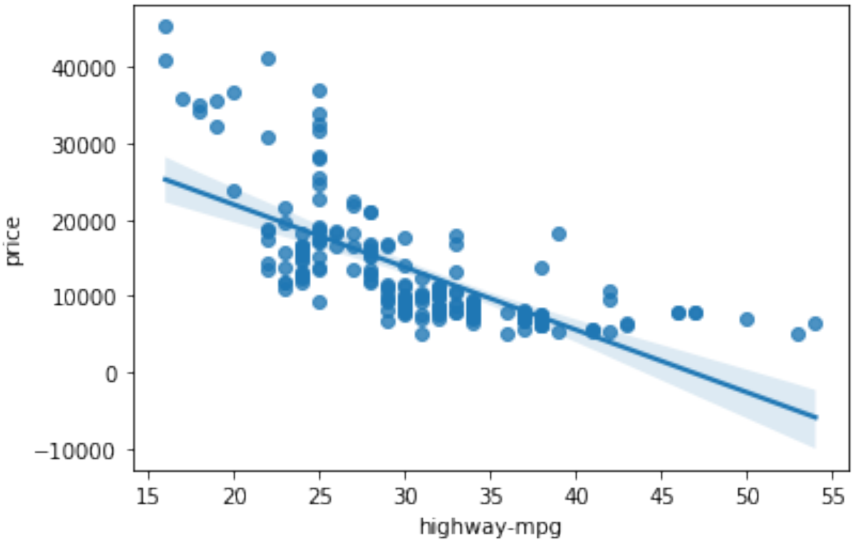

45000
40000
35000
30000
25000
20000
15000
10000
5000
price
2.0
2.5
3.0
3.5
4.0
stroke

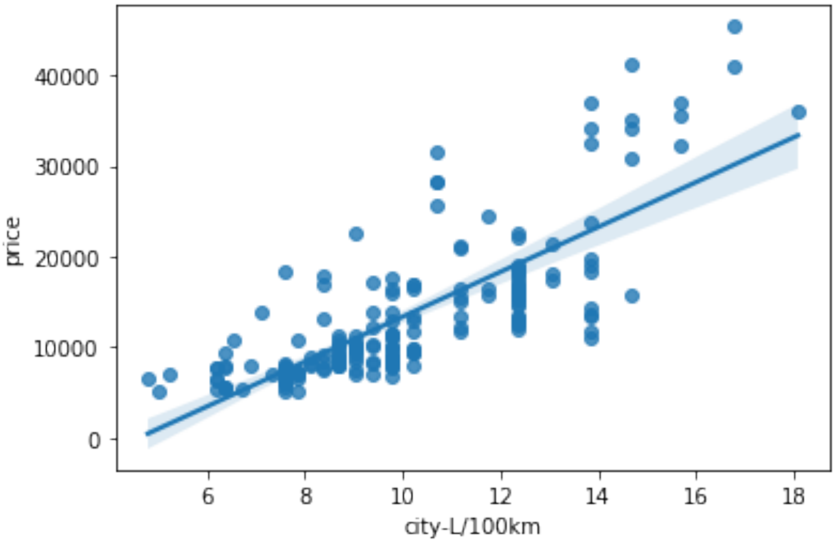

45000
40000
35000
30000
25000
20000
15000
10000
5000
price
8
10
12
14
16
18
20
22
compression-ratio

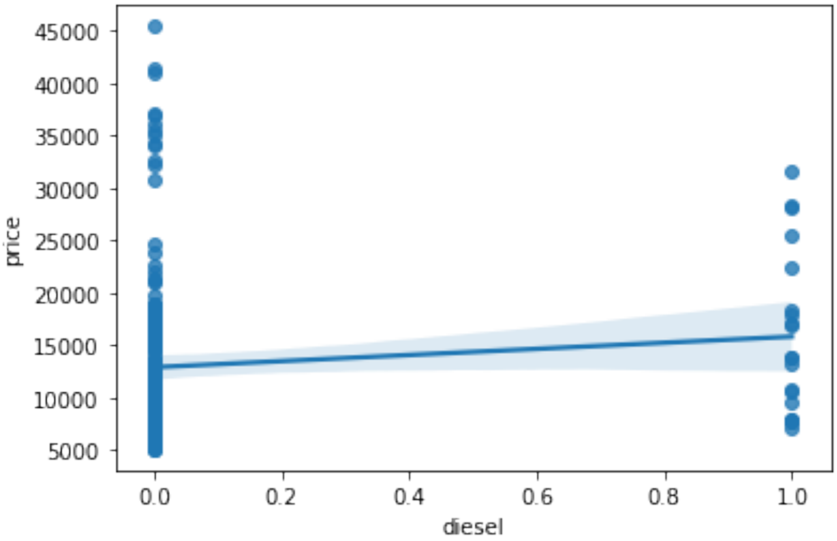

40000
30000
20000
10000
price
50
100
150
200
250
horsepower

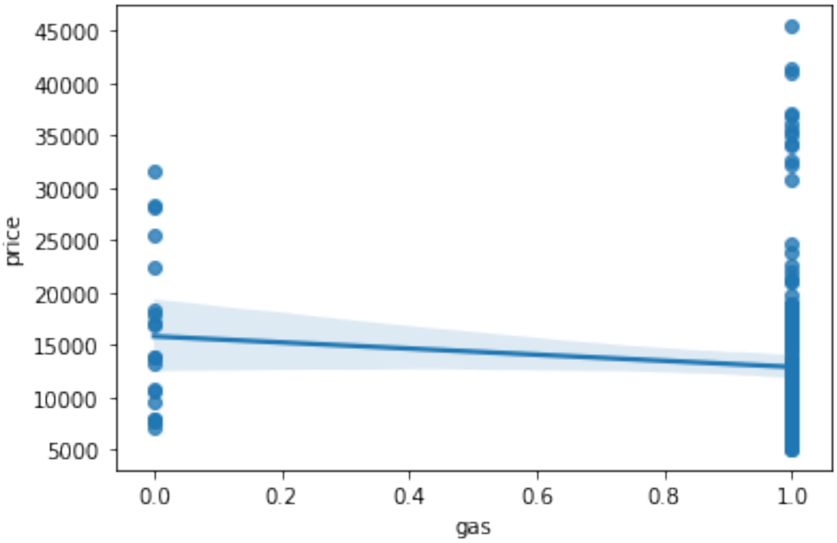

price
45000
40000
35000
30000
25000
20000
15000
10000
5000
4500
5000
5500
6000
6500
peak-rpm


price
40000
30000
20000
10000
0
−10000
15
20
25
30
35
40
45
50
city-mpg


price
40000
30000
20000
10000
0
−10000
15
20
25
30
35
40
45
50
55
highway-mpg



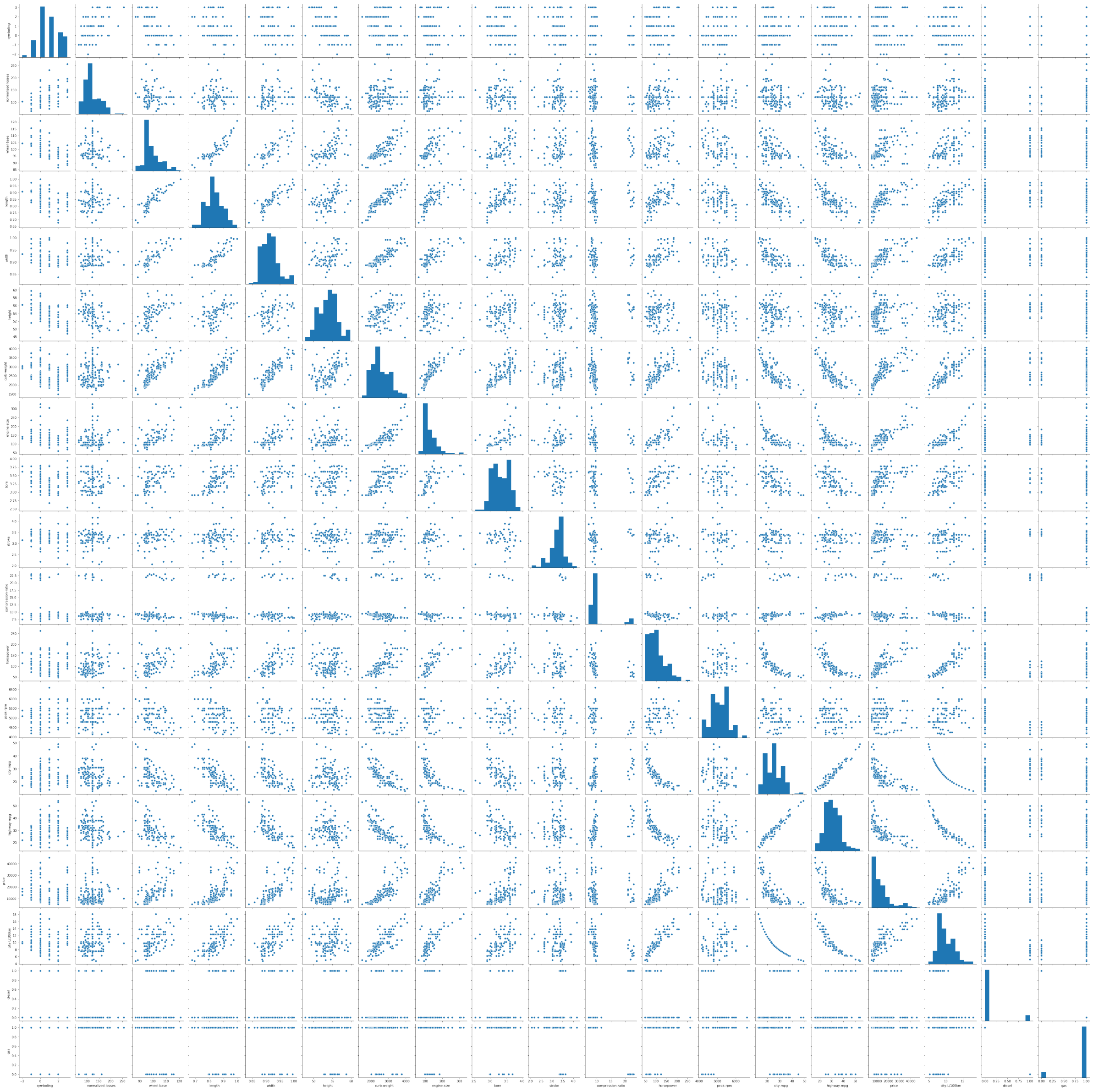




Using the SNS pairplot function

In [20]:

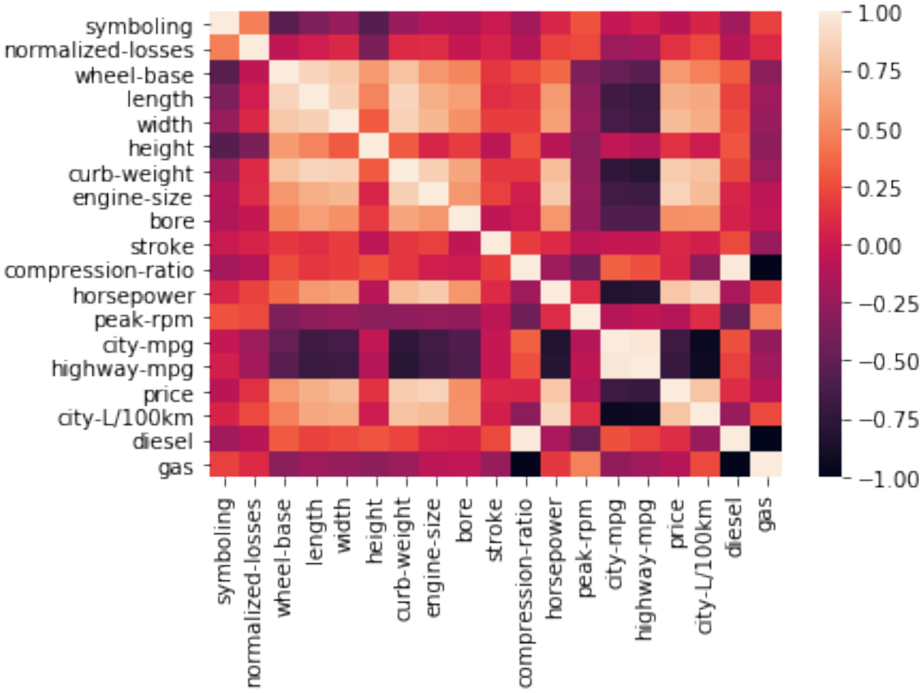
```
sns.pairplot(cars);
```



Viewing Heatmap of the correlation

In [21]:

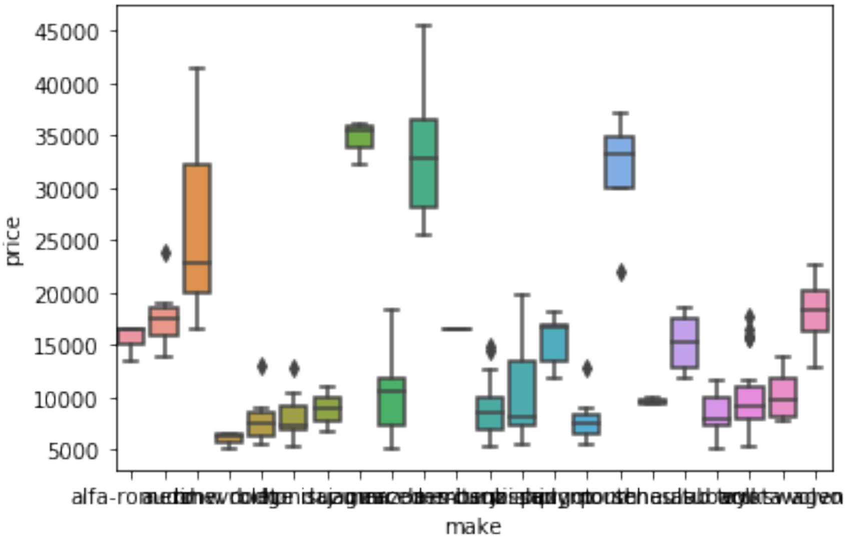
```
sns.heatmap(correlation)
plt.show()
```

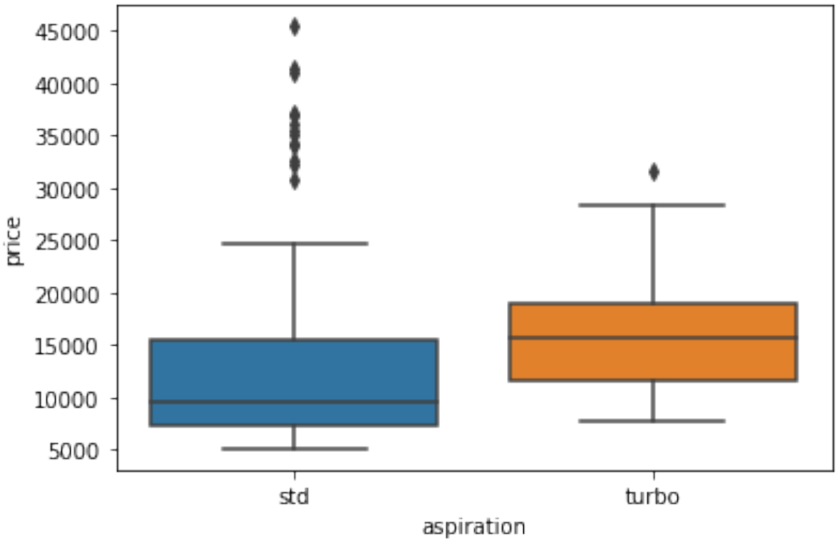


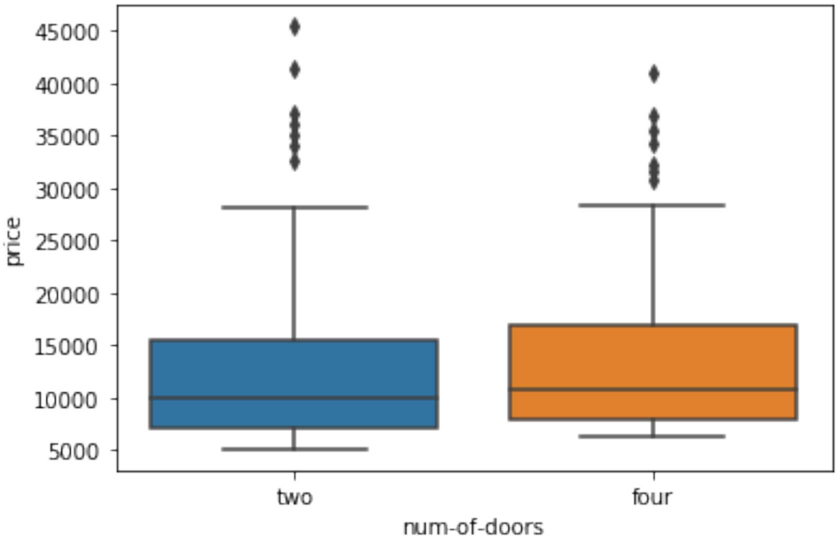
With seaborn boxplot() - comparing “body-style” with “price” and for other categorical variables

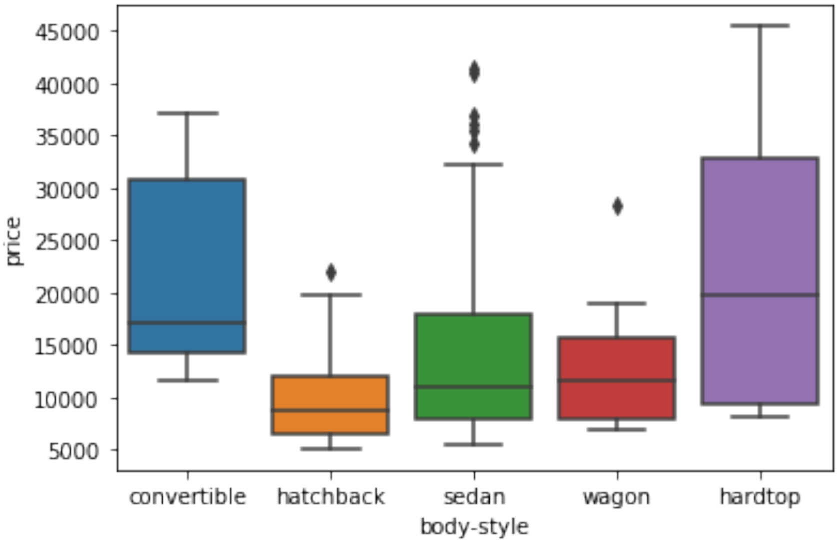
In [22]:

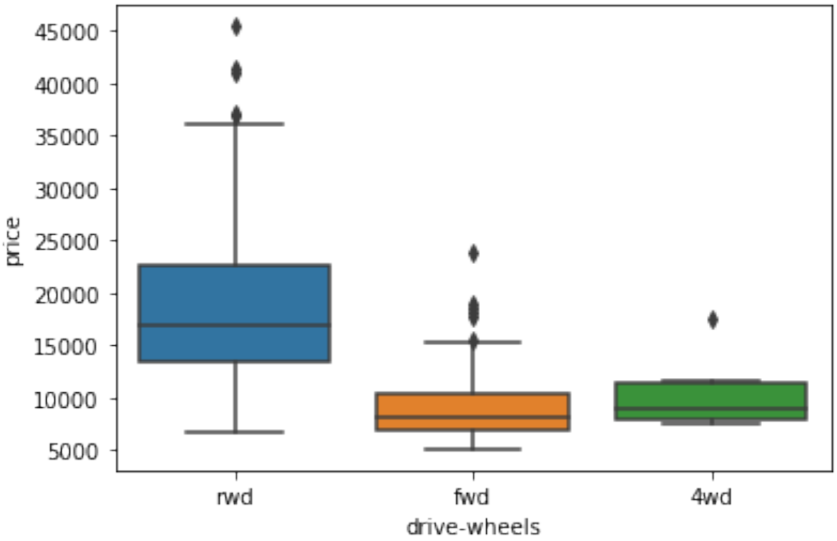
```
for i in cars.describe(include = np.object).columns:
    sns.boxplot(x=cars[i], y=cars.price)
    plt.show()
```

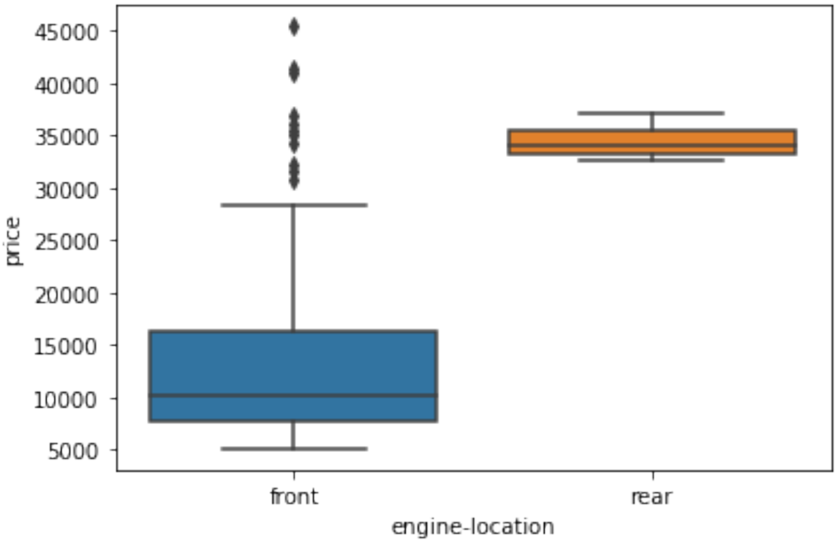


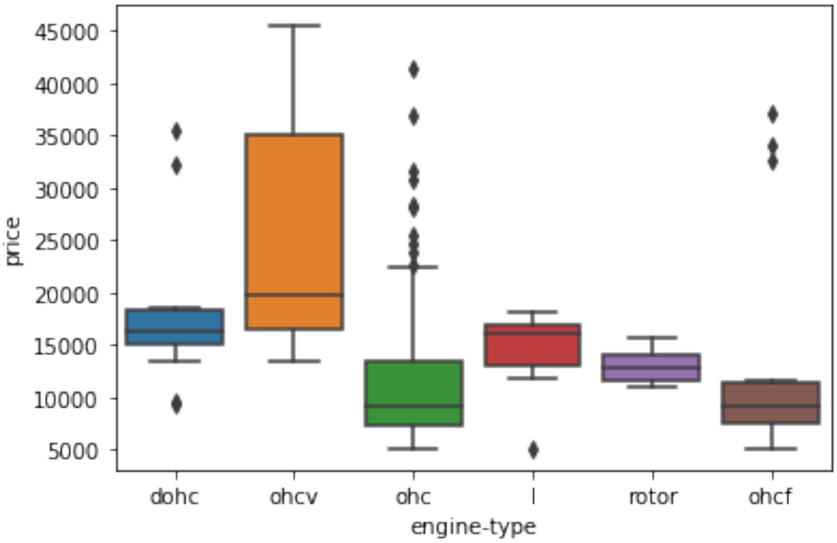

45000
40000
35000
30000
25000
20000
15000
10000
5000
price
std
turbo
aspiration

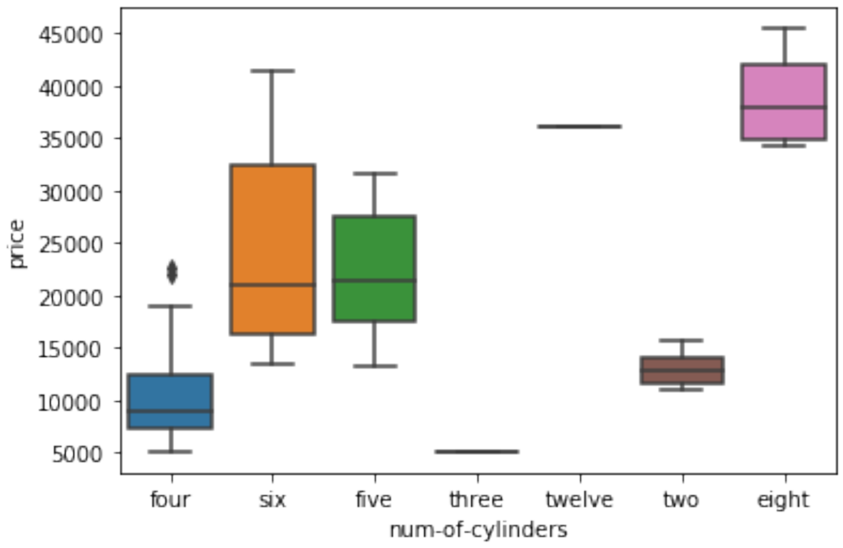

45000
40000
35000
30000
25000
20000
15000
10000
5000
price
two
four
num-of-doors

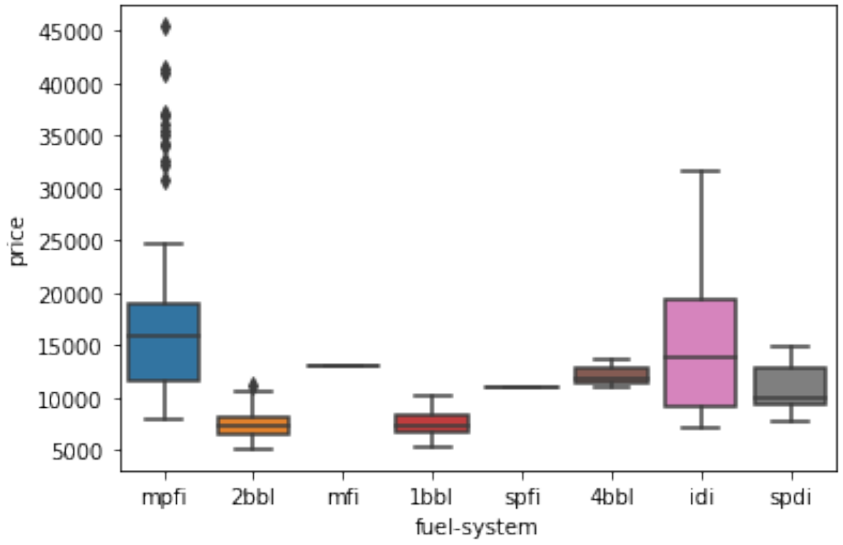

45000
40000
35000
30000
25000
20000
15000
10000
5000
price
convertible
hatchback
sedan
wagon
hardtop
body-style

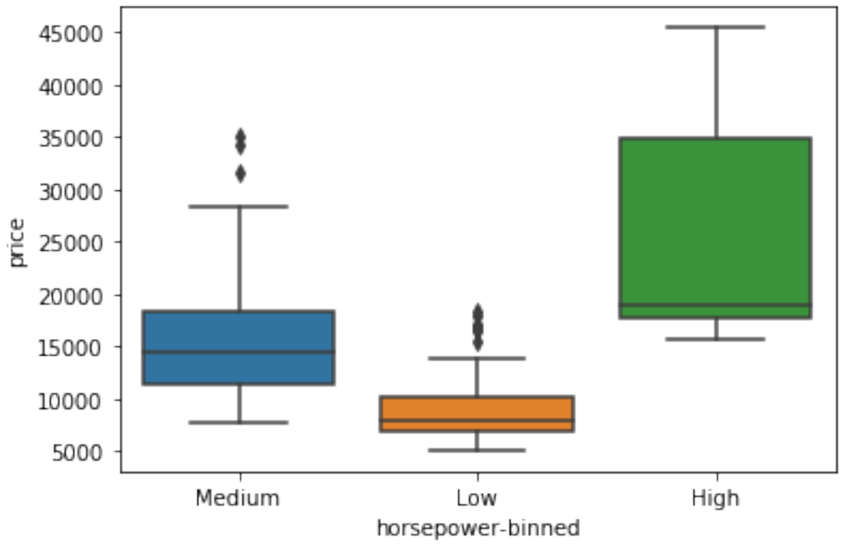

price
45000
40000
35000
30000
25000
20000
15000
10000
5000
rwd
fwd
4wd
drive-wheels


price
45000
40000
35000
30000
25000
20000
15000
10000
5000
front
rear
engine-location


price
45000
40000
35000
30000
25000
20000
15000
10000
5000
dohc
ohcv
ohc
l
rotor
ohcf
engine-type







Observations :- body-style - We see that the distributions of price between the different body-style categories have a significant overlap, and so body-style would not be a good predictor of price. More or less the price range for every body type car is well defined with rarely any outliers, with the excpetion of sedan. There are a lot of sport sedans which cost more than the average sedan and cost more and hence are outliers in the data. drive-wheels - Here we see that the distribution of price between these two engine-location categories, front and rear, are distinct enough to take engine-location as a potential good predictor of price. Majority of the cars have rear wheel drive and have very few outliers. Cars with front wheel or all wheel drive are fairly less and have a very short and well defined range for their price. engine-location - Here we see that the distribution of price between the different drive-wheels categories differs; as such drive-wheels could potentially be a predictor of price. The majority of the cars have enging in the front and the and have a well defined price range. The cars with rear engines and the outliers of cars with front engines are majorly sports cars and that is why they are priced higher overall. horsepower-binned - We can see that as the horsepower of a car increases, the price of the car also increases and the range to define the price of a car with low, medium or high horsepower gets broaded and broader. Using describe() to get descriptive statistics of numeric variables

In [24]:

```
cars.describe()
```

Out[24]:

	symboling	normalized-losses	wheel-base	length	width	height	curb-weig
count	201.000000	201.00000	201.000000	201.000000	201.000000	201.000000	201.0000
mean	0.840796	122.00000	98.797015	0.837102	0.915126	53.766667	2555.6666
std	1.254802	31.99625	6.066366	0.059213	0.029187	2.447822	517.2967
min	-2.000000	65.00000	86.600000	0.678039	0.837500	47.800000	1488.0000
25%	0.000000	101.00000	94.500000	0.801538	0.890278	52.000000	2169.0000
50%	1.000000	122.00000	97.000000	0.832292	0.909722	54.100000	2414.0000
75%	2.000000	137.00000	102.400000	0.881788	0.925000	55.500000	2926.0000
max	3.000000	256.00000	120.900000	1.000000	1.000000	59.800000	4066.0000

Using describe() to get stats of categorical variablesThe default setting of "describe" skips variables of type object. We can apply the method "describe" on the variables of type 'object' as follows:

In [26]:

```
cars.describe(include=np.object)
```

Out[26]:

	make	aspiration	num-of-doors	body-style	drive-wheels	engine-location	engine-type	num-of-cylinders	fuel-system	hor
count	201	201	201	201	201	201	201	201	201	
unique	22	2	2	5	3	2	6	7	8	
top	toyota	std	four	sedan	fwd	front	ohc	four	mpfi	
freq	32	165	115	94	118	198	145	157	92	

Getting unique values in each categorical variable along with their frequency.

In [28]:

```
for i in cars.describe(include=np.object).columns:
    print(i)
    print(cars[i].value_counts())
    print("")
    print("")
```

```
make
toyota           32
nissan           18
mazda            17
mitsubishi       13
honda            13
subaru           12
volkswagen       12
peugot           11
volvo            11
dodge             9
bmw               8
mercedes-benz     8
plymouth          7
audi              6
saab              6
porsche           4
chevrolet         3
alfa-romero       3
jaguar            3
renault           2
isuzu             2
mercury           1
Name: make, dtype: int64


aspiration
```

```
std      165
turbo     36
Name: aspiration, dtype: int64


num-of-doors
four    115
two      86
Name: num-of-doors, dtype: int64


body-style
sedan          94
hatchback      68
wagon          25
hardtop         8
convertible     6
Name: body-style, dtype: int64


drive-wheels
fwd    118
rwd     75
4wd      8
Name: drive-wheels, dtype: int64


engine-location
front    198
rear       3
Name: engine-location, dtype: int64


engine-type
ohc      145
ohcf      15
ohcv      13
dohc      12
l         12
rotor      4
Name: engine-type, dtype: int64


num-of-cylinders
four      157
six        24
five       10
two         4
eight       4
twelve      1
three       1
Name: num-of-cylinders, dtype: int64
```

```
fuel-system
mpfi     92
2bbl     64
idi      20
1bbl     11
spdi      9
4bbl      3
mfi       1
spfi      1
Name: fuel-system, dtype: int64


horsepower-binned
Low       115
Medium     62
High       23
Name: horsepower-binned, dtype: int64
```

Value-counts is a good way of understanding how many units of each characteristic/variable we have. We can apply the "value_counts" method on the column 'drive-wheels'. Don’t forget the method "value_counts" only works on Pandas series, not Pandas Dataframes. As a result, we only include one bracket "df['drive-wheels']" not two brackets "df[['drive-wheels']]".Using groupby() to get the average price of “drive-wheels” wrt “price”

In [29]:

```
for i in cars.describe(include=np.object).columns:
    print(cars.groupby(i)['price'].mean())
    print("")
    print("")
```

```
make
alfa-romero      15498.333333
audi             17859.166667
bmw              26118.750000
chevrolet         6007.000000
dodge             7875.444444
honda             8184.692308
isuzu             8916.500000
jaguar           34600.000000
mazda            10652.882353
mercedes-benz    33647.000000
mercury          16503.000000
mitsubishi        9239.769231
nissan           10415.666667
peugot           15489.090909
plymouth          7963.428571
porsche          31400.500000
renault           9595.000000
saab             15223.333333
subaru            8541.250000
```

```
toyota            9885.812500
volkswagen       10077.500000
volvo            18063.181818
Name: price, dtype: float64


aspiration
std      12542.181818
turbo    16254.805556
Name: price, dtype: float64


num-of-doors
four    13498.034783
two     12818.127907
Name: price, dtype: float64


body-style
convertible    21890.500000
hardtop        22208.500000
hatchback       9957.441176
sedan          14459.755319
wagon          12371.960000
Name: price, dtype: float64


drive-wheels
4wd    10241.000000
fwd     9244.779661
rwd    19757.613333
Name: price, dtype: float64


engine-location
front    12884.085859
rear     34528.000000
Name: price, dtype: float64


engine-type
dohc     18116.416667
l        14627.583333
ohc      11567.358621
ohcf     13738.600000
ohcv     25098.384615
rotor    13020.000000
Name: price, dtype: float64


num-of-cylinders
eight     38900.000000
five      22007.600000
```

```
four      10303.197452
six       23671.833333
three      5151.000000
twelve    36000.000000
two       13020.000000
Name: price, dtype: float64


fuel-system
1bbl     7555.545455
2bbl     7433.203125
4bbl    12145.000000
idi     15838.150000
mfi     12964.000000
mpfi    17605.141304
spdi    10990.444444
spfi    11048.000000
Name: price, dtype: float64


horsepower-binned
High      25899.130435
Low        9011.704348
Medium    15913.016129
Name: price, dtype: float64
```

The "groupby" method groups data by different categories. The data is grouped based on one or several variables and analysis is performed on the individual groups. From our data, it seems rear-wheel drive vehicles are, on average, the most expensive, while 4-wheel and front-wheel are approximately the same in price.

In [30]:

```
cars.groupby(['drive-wheels','body-style'])['price'].mean()
```

Out[30]:

```
drive-wheels  body-style 
4wd           hatchback       7603.000000
              sedan          12647.333333
              wagon           9095.750000
fwd           convertible    11595.000000
              hardtop         8249.000000
              hatchback       8396.387755
              sedan           9811.800000
              wagon           9997.333333
rwd           convertible    23949.600000
              hardtop        24202.714286
              hatchback      14337.777778
              sedan          21711.833333
              wagon          16994.222222
Name: price, dtype: float64
```

- We can see that there are no convertibles or hardtops in the 4 wheel drive and the avergae price of sedan cars is the most in a 4 wheel drive system. - We can see that convertibles have a higher overall price average in forward wheel drive, while hatchback and hardtop and sedan and wagon are relatively close in their average pricing. - We can see that rear wheel drive convertibles are the most expensive closely followed by the hardtop carsCreating Pivot tables: Using pivot() on the result of step 19 to get “drive-wheels” as index and “body-style” as columns.

In [41]:

```
a = cars[['drive-wheels','body-style','price']]
pivot = a.groupby(['drive-wheels','body-style'], as_index=False).mean()
pivot_table = pivot.pivot(index = 'drive-wheels', columns = 'body-style')
pivot_table
```

Out[41]:

	price				
body-style	**convertible**	**hardtop**	**hatchback**	**sedan**	**wagon**
drive-wheels					
4wd	NaN	NaN	7603.000000	12647.333333	9095.750000
fwd	11595.0	8249.000000	8396.387755	9811.800000	9997.333333
rwd	23949.6	24202.714286	14337.777778	21711.833333	16994.222222

In [ ]:

In [42]:

```
col = cars.describe(include=np.object).columns
redundant = []
for i in col:
    redundant.append(i)
    for j in col:
        if i==j or j in redundant:
            continue
        else:
            a = cars.groupby([i,j])['price'].mean()
            print(a, end='\n \n')
            a = cars[[i,j,'price']]
            pivot = a.groupby([i,j], as_index=False).mean()
            pivot = pivot.pivot(index = i, columns = j)
            pivot.replace(np.nan, '-', inplace= True)
            print('Pivot Table')
            print(pivot)
            print("")
            print("", end='\n\n')
```

```
make           aspiration
alfa-romero    std           15498.333333
audi           std           16656.000000
               turbo         23875.000000
bmw            std           26118.750000
chevrolet      std            6007.000000
dodge          std            6900.000000
               turbo          9826.333333
honda          std            8184.692308
isuzu          std            8916.500000
jaguar         std           34600.000000
mazda          std           10652.882353
mercedes-benz  std           38900.000000
               turbo         28394.000000
mercury        turbo         16503.000000
mitsubishi     std            7314.714286
               turbo         11485.666667
nissan         std            9869.588235
               turbo         19699.000000
peugot         std           14649.000000
               turbo         16189.166667
plymouth       std            7004.600000
               turbo         10360.500000
porsche        std           31400.500000
renault        std            9595.000000
saab           std           13642.500000
               turbo         18385.000000
subaru         std            7954.200000
               turbo         11476.500000
toyota         std            9859.612903
               turbo         10698.000000
volkswagen     std            9759.000000
```

```
               turbo         11670.000000
volvo          std           16197.500000
               turbo         20302.000000
Name: price, dtype: float64

Pivot Table
                 price
aspiration         std    turbo
make
alfa-romero    15498.3        -
audi             16656    23875
bmw            26118.8        -
chevrolet         6007        -
dodge             6900  9826.33
honda          8184.69        -
isuzu           8916.5        -
jaguar           34600        -
mazda          10652.9        -
mercedes-benz    38900    28394
mercury              -    16503
mitsubishi     7314.71  11485.7
nissan         9869.59    19699
peugot           14649  16189.2
plymouth        7004.6  10360.5
porsche        31400.5        -
renault           9595        -
saab           13642.5    18385
subaru          7954.2  11476.5
toyota         9859.61    10698
volkswagen        9759    11670
volvo          16197.5    20302



make           num-of-doors
alfa-romero    two             15498.333333
audi           four            18381.000000
               two             15250.000000
bmw            four            26047.000000
               two             26238.333333
chevrolet      four             6575.000000
               two              5723.000000
dodge          four             7601.800000
               two              8217.500000
honda          four             9335.000000
               two              7465.750000
isuzu          four             6785.000000
               two             11048.000000
jaguar         four            33900.000000
               two             36000.000000
mazda          four            11436.750000
               two              9956.111111
mercedes-benz  four            32108.800000
```

```
               two               36210.666667
mercury        two               16503.000000
mitsubishi     four               8434.000000
               two                9597.888889
nissan         four               9954.555556
               two               10876.777778
peugot         four              15489.090909
plymouth       four               7362.750000
               two                8764.333333
porsche        two               31400.500000
renault        four               9295.000000
               two                9895.000000
saab           four              15433.333333
               two               15013.333333
subaru         four               9191.222222
               two                6591.333333
toyota         four               9359.888889
               two               10562.000000
volkswagen     four              10450.625000
               two                9331.250000
volvo          four              18063.181818
Name: price, dtype: float64

Pivot Table
                 price
num-of-doors      four      two
make
alfa-romero          -  15498.3
audi             18381    15250
bmw              26047  26238.3
chevrolet         6575     5723
dodge           7601.8   8217.5
honda             9335  7465.75
isuzu             6785    11048
jaguar           33900    36000
mazda          11436.8  9956.11
mercedes-benz  32108.8  36210.7
mercury              -    16503
mitsubishi        8434  9597.89
nissan         9954.56  10876.8
peugot         15489.1        -
plymouth       7362.75  8764.33
porsche              -  31400.5
renault           9295     9895
saab           15433.3  15013.3
subaru         9191.22  6591.33
toyota         9359.89    10562
volkswagen     10450.6  9331.25
volvo          18063.2        -



make           body-style
```

```
alfa-romero    convertible    14997.500000
               hatchback      16500.000000
audi           sedan          17647.000000
               wagon          18920.000000
bmw            sedan          26118.750000
chevrolet      hatchback       5723.000000
               sedan           6575.000000
dodge          hatchback       7819.800000
               sedan           7619.666667
               wagon           8921.000000
honda          hatchback       7054.428571
               sedan           9945.000000
               wagon           7295.000000
isuzu          hatchback      11048.000000
               sedan           6785.000000
jaguar         sedan          34600.000000
mazda          hatchback      10085.000000
               sedan          11464.142857
mercedes-benz  convertible    35056.000000
               hardtop        36788.000000
               sedan          33074.000000
               wagon          28248.000000
mercury        hatchback      16503.000000
mitsubishi     hatchback       9597.888889
               sedan           8434.000000
nissan         hardtop         8249.000000
               hatchback      14409.000000
               sedan           8604.555556
               wagon           9915.666667
peugot         sedan          15758.571429
               wagon          15017.500000
plymouth       hatchback       8130.500000
               sedan           7150.500000
               wagon           8921.000000
porsche        convertible    37028.000000
               hardtop        33278.000000
               hatchback      22018.000000
renault        hatchback       9895.000000
               wagon           9295.000000
saab           hatchback      15013.333333
               sedan          15433.333333
subaru         hatchback       6591.333333
               sedan           9070.600000
               wagon           9342.000000
toyota         convertible    17669.000000
               hardtop         9762.333333
               hatchback       9616.000000
               sedan           9542.200000
               wagon           9836.000000
volkswagen     convertible    11595.000000
               hatchback       9980.000000
               sedan           9673.888889
               wagon          12290.000000
```

```
volvo          sedan          18726.875000
               wagon          16293.333333
Name: price, dtype: float64

Pivot Table
                  price
body-style    convertible  hardtop hatchback    sedan    wagon
make
alfa-romero       14997.5        -     16500        -        -
audi                    -        -         -    17647    18920
bmw                     -        -         -  26118.8        -
chevrolet               -        -      5723     6575        -
dodge                   -        -    7819.8  7619.67     8921
honda                   -        -   7054.43     9945     7295
isuzu                   -        -     11048     6785        -
jaguar                  -        -         -    34600        -
mazda                   -        -     10085  11464.1        -
mercedes-benz       35056    36788         -    33074    28248
mercury                 -        -     16503        -        -
mitsubishi              -        -   9597.89     8434        -
nissan                  -     8249     14409  8604.56  9915.67
peugot                  -        -         -  15758.6  15017.5
plymouth                -        -    8130.5   7150.5     8921
porsche             37028    33278     22018        -        -
renault                 -        -      9895        -     9295
saab                    -        -   15013.3  15433.3        -
subaru                  -        -   6591.33   9070.6     9342
toyota              17669  9762.33      9616   9542.2     9836
volkswagen          11595        -      9980  9673.89    12290
volvo                   -        -         -  18726.9  16293.3



make           drive-wheels
alfa-romero    rwd              15498.333333
audi           4wd              17450.000000
               fwd              17941.000000
bmw            rwd              26118.750000
chevrolet      fwd               6007.000000
dodge          fwd               7875.444444
honda          fwd               8184.692308
isuzu          rwd               8916.500000
jaguar         rwd              34600.000000
mazda          fwd               8399.545455
               rwd              14784.000000
mercedes-benz  rwd              33647.000000
mercury        rwd              16503.000000
mitsubishi     fwd               9239.769231
nissan         fwd               8812.333333
               rwd              18432.333333
peugot         rwd              15489.090909
plymouth       fwd               7163.333333
               rwd              12764.000000
```

```
porsche         rwd              31400.500000
renault         fwd               9595.000000
saab            fwd              15223.333333
subaru          4wd               9560.400000
                fwd               7813.285714
toyota          4wd               8338.000000
                fwd               8253.000000
                rwd              11973.000000
volkswagen      fwd              10077.500000
volvo           rwd              18063.181818
Name: price, dtype: float64

Pivot Table
                price
drive-wheels      4wd      fwd      rwd
make
alfa-romero         -        -  15498.3
audi            17450    17941        -
bmw                 -        -  26118.8
chevrolet           -     6007        -
dodge               -  7875.44        -
honda               -  8184.69        -
isuzu               -        -   8916.5
jaguar              -        -    34600
mazda               -  8399.55    14784
mercedes-benz       -        -    33647
mercury             -        -    16503
mitsubishi          -  9239.77        -
nissan              -  8812.33  18432.3
peugot              -        -  15489.1
plymouth            -  7163.33    12764
porsche             -        -  31400.5
renault             -     9595        -
saab                -  15223.3        -
subaru         9560.4  7813.29        -
toyota           8338     8253    11973
volkswagen          -  10077.5        -
volvo               -        -  18063.2



make            engine-location
alfa-romero     front                15498.333333
audi            front                17859.166667
bmw             front                26118.750000
chevrolet       front                 6007.000000
dodge           front                 7875.444444
honda           front                 8184.692308
isuzu           front                 8916.500000
jaguar          front                34600.000000
mazda           front                10652.882353
mercedes-benz   front                33647.000000
mercury         front                16503.000000
```

```
mitsubishi     front               9239.769231
nissan         front              10415.666667
peugot         front              15489.090909
plymouth       front               7963.428571
porsche        front              22018.000000
               rear               34528.000000
renault        front               9595.000000
saab           front              15223.333333
subaru         front               8541.250000
toyota         front               9885.812500
volkswagen     front              10077.500000
volvo          front              18063.181818
Name: price, dtype: float64

Pivot Table
                        price       
engine-location         front   rear
make                                
alfa-romero      15498.333333      -
audi             17859.166667      -
bmw              26118.750000      -
chevrolet         6007.000000      -
dodge             7875.444444      -
honda             8184.692308      -
isuzu             8916.500000      -
jaguar           34600.000000      -
mazda            10652.882353      -
mercedes-benz    33647.000000      -
mercury          16503.000000      -
mitsubishi        9239.769231      -
nissan           10415.666667      -
peugot           15489.090909      -
plymouth          7963.428571      -
porsche          22018.000000  34528
renault           9595.000000      -
saab             15223.333333      -
subaru            8541.250000      -
toyota            9885.812500      -
volkswagen       10077.500000      -
volvo            18063.181818      -
```

```
make           engine-type
alfa-romero    dohc           14997.500000
               ohcv           16500.000000
audi           ohc            17859.166667
bmw            ohc            26118.750000
chevrolet      l               5151.000000
               ohc             6435.000000
dodge          ohc             7875.444444
honda          ohc             8184.692308
isuzu          ohc             8916.500000
```

```
jaguar         dohc           33900.000000
               ohcv           36000.000000
mazda          ohc             9924.538462
               rotor          13020.000000
mercedes-benz  ohc            28394.000000
               ohcv           38900.000000
mercury        ohc            16503.000000
mitsubishi     ohc             9239.769231
nissan         ohc             7565.666667
               ohcv           16115.666667
peugot         l              15489.090909
plymouth       ohc             7963.428571
porsche        ohc            22018.000000
               ohcf           34528.000000
renault        ohc             9595.000000
saab           dohc           18385.000000
               ohc            13642.500000
subaru         ohcf            8541.250000
toyota         dohc           13805.333333
               ohc             8981.307692
volkswagen     ohc            10077.500000
volvo          ohc            17721.000000
               ohcv           21485.000000
Name: price, dtype: float64

Pivot Table
                 price
engine-type       dohc        l      ohc     ohcf     ohcv  rotor
make
alfa-romero    14997.5        -        -        -    16500      -
audi                 -        -  17859.2        -        -      -
bmw                  -        -  26118.8        -        -      -
chevrolet            -     5151     6435        -        -      -
dodge                -        -  7875.44        -        -      -
honda                -        -  8184.69        -        -      -
isuzu                -        -   8916.5        -        -      -
jaguar           33900        -        -        -    36000      -
mazda                -        -  9924.54        -        -  13020
mercedes-benz        -        -    28394        -    38900      -
mercury              -        -    16503        -        -      -
mitsubishi           -        -  9239.77        -        -      -
nissan               -        -  7565.67        -  16115.7      -
peugot               -  15489.1        -        -        -      -
plymouth             -        -  7963.43        -        -      -
porsche              -        -    22018    34528        -      -
renault              -        -     9595        -        -      -
saab             18385        -  13642.5        -        -      -
subaru               -        -        -  8541.25        -      -
toyota         13805.3        -  8981.31        -        -      -
volkswagen           -        -  10077.5        -        -      -
volvo                -        -    17721        -    21485      -
```

```
make           num-of-cylinders
alfa-romero    four                14997.500000
               six                 16500.000000
audi           five                18641.000000
               four                13950.000000
bmw            four                16677.500000
               six                 29265.833333
chevrolet      four                 6435.000000
               three                5151.000000
dodge          four                 7875.444444
honda          four                 8184.692308
isuzu          four                 8916.500000
jaguar         six                 33900.000000
               twelve              36000.000000
mazda          four                 9924.538462
               two                 13020.000000
mercedes-benz  eight               38900.000000
               five                28394.000000
mercury        four                16503.000000
mitsubishi     four                 9239.769231
nissan         four                 7565.666667
               six                 16115.666667
peugot         four                15489.090909
plymouth       four                 7963.428571
porsche        four                22018.000000
               six                 34528.000000
renault        four                 9595.000000
saab           four                15223.333333
subaru         four                 8541.250000
toyota         four                 9012.500000
               six                 15999.000000
volkswagen     five                13295.000000
               four                 9785.000000
volvo          four                17193.333333
               six                 21977.500000
Name: price, dtype: float64

Pivot Table
                  price                                               
num-of-cylinders  eight   five     four       six three twelve    t
wo
make                                                                 
alfa-romero           -      -  14997.5     16500     -      -  
-
audi                  -  18641    13950         -     -      -  
-
bmw                   -      -  16677.5   29265.8     -      -  
-
chevrolet             -      -     6435         -  5151      -  
-
dodge                 -      -  7875.44         -     -      -  
-
```

```
honda                 -      -  8184.69        -     -      -
-
isuzu                 -      -   8916.5        -     -      -
-
jaguar                -      -        -    33900     -  36000
-
mazda                 -      -  9924.54        -     -      -  130
20
mercedes-benz     38900  28394        -        -     -      -
-
mercury               -      -    16503        -     -      -
-
mitsubishi            -      -  9239.77        -     -      -
-
nissan                -      -  7565.67  16115.7     -      -
-
peugot                -      -  15489.1        -     -      -
-
plymouth              -      -  7963.43        -     -      -
-
porsche               -      -    22018    34528     -      -
-
renault               -      -     9595        -     -      -
-
saab                  -      -  15223.3        -     -      -
-
subaru                -      -  8541.25        -     -      -
-
toyota                -      -   9012.5    15999     -      -
-
volkswagen            -  13295     9785        -     -      -
-
volvo                 -      -  17193.3  21977.5     -      -
-
```

```
make           fuel-system
alfa-romero    mpfi           15498.333333
audi           mpfi           17859.166667
bmw            mpfi           26118.750000
chevrolet      2bbl            6007.000000
dodge          2bbl            6900.000000
               mfi            12964.000000
               mpfi            8257.500000
honda          1bbl            7555.545455
               2bbl           10345.000000
               mpfi           12945.000000
isuzu          2bbl            6785.000000
               spfi           11048.000000
jaguar         mpfi           34600.000000
mazda          2bbl            8160.000000
               4bbl           12145.000000
               idi            14569.500000
               mpfi           16962.500000
mercedes-benz  idi            28394.000000
               mpfi           38900.000000
mercury        mpfi           16503.000000
mitsubishi     2bbl            6987.333333
               spdi           11170.428571
nissan         2bbl            7608.090909
               idi             7099.000000
               mpfi           16115.666667
peugot         idi            15797.000000
               mpfi           15232.500000
plymouth       2bbl            7004.600000
               spdi           10360.500000
porsche        mpfi           31400.500000
renault        mpfi            9595.000000
saab           mpfi           15223.333333
subaru         2bbl            7423.000000
               mpfi           10777.750000
toyota         2bbl            7504.153846
               idi             8794.666667
               mpfi           12025.500000
volkswagen     idi             9777.500000
               mpfi           10227.500000
volvo          idi            22470.000000
               mpfi           17622.500000
Name: price, dtype: float64

Pivot Table
                 price
\
fuel-system       1bbl     2bbl   4bbl      idi    mfi     mpfi
spdi
make
alfa-romero          -        -      -        -      -  15498.3
-
audi                 -        -      -        -      -  17859.2
-
bmw                  -        -      -        -      -  26118.8
-
chevrolet            -     6007      -        -      -        -
-
dodge                -     6900      -        -  12964   8257.5
-
honda          7555.55    10345      -        -      -    12945
-
isuzu                -     6785      -        -      -        -
-
jaguar               -        -      -        -      -    34600
-
mazda                -     8160  12145  14569.5      -  16962.5
-
mercedes-benz        -        -      -    28394      -    38900
```

```
-
mercury           -       -     -       -     -   16503
-
mitsubishi        -  6987.33    -       -     -       -  1
1170.4
nissan            -  7608.09    -    7099     -  16115.7
-
peugot            -       -     -   15797     -  15232.5
-
plymouth          -   7004.6    -       -     -       -  1
0360.5
porsche           -       -     -       -     -  31400.5
-
renault           -       -     -       -     -    9595
-
saab              -       -     -       -     -  15223.3
-
subaru            -     7423    -       -     -  10777.8
-
toyota            -  7504.15    -  8794.67    -  12025.5
-
volkswagen        -       -     -   9777.5    -  10227.5
-
volvo             -       -     -   22470     -  17622.5
-


fuel-system     spfi
make
alfa-romero        -
audi               -
bmw                -
chevrolet          -
dodge              -
honda              -
isuzu          11048
jaguar             -
mazda              -
mercedes-benz      -
mercury            -
mitsubishi         -
nissan             -
peugot             -
plymouth           -
porsche            -
renault            -
saab               -
subaru             -
toyota             -
volkswagen         -
volvo              -
```

```
make           horsepower-binned
alfa-romero    Medium               15498.333333
audi           Medium               17859.166667
bmw            High                 36318.333333
               Low                  16677.500000
               Medium               22213.333333
chevrolet      Low                   6007.000000
dodge          Low                   6900.000000
               Medium                9826.333333
honda          Low                   8184.692308
isuzu          Low                   8916.500000
jaguar         High                 33900.000000
mazda          Low                   9811.600000
               Medium               16962.500000
mercedes-benz  High                 43180.000000
               Medium               30469.333333
mercury        High                 16503.000000
mitsubishi     Low                   6987.333333
               Medium               11170.428571
nissan         High                 18432.333333
               Low                   7565.666667
               Medium               13799.000000
peugot         Low                  15223.000000
               Medium               18150.000000
plymouth       Low                   7004.600000
               Medium               10360.500000
porsche        High                 34528.000000
               Medium               22018.000000
renault        Medium                9595.000000
saab           High                 18385.000000
               Medium               13642.500000
subaru         Low                   7954.200000
               Medium               11476.500000
toyota         High                 15999.000000
               Low                   8251.000000
               Medium               10916.250000
volkswagen     Low                   9785.000000
               Medium               13295.000000
volvo          High                 18805.000000
               Medium               17785.000000
Name: price, dtype: float64

Pivot Table
                     price
horsepower-binned     High       Low   Medium
make
alfa-romero              -         -  15498.3
audi                     -         -  17859.2
bmw                36318.3   16677.5  22213.3
chevrolet                -      6007        -
dodge                    -      6900  9826.33
honda                    -   8184.69        -
```

```
isuzu                    -   8916.5        -
jaguar               33900        -        -
mazda                    -   9811.6  16962.5
mercedes-benz        43180        -  30469.3
mercury              16503        -        -
mitsubishi               -  6987.33  11170.4
nissan             18432.3  7565.67    13799
peugot                   -    15223    18150
plymouth                 -   7004.6  10360.5
porsche              34528        -    22018
renault                  -        -     9595
saab                 18385        -  13642.5
subaru                   -   7954.2  11476.5
toyota               15999     8251  10916.2
volkswagen               -     9785    13295
volvo                18805        -    17785
```

```
aspiration  num-of-doors
std         four            12509.847826
            two             12582.931507
turbo       four            17450.782609
            two             14138.846154
Name: price, dtype: float64

Pivot Table
                    price
num-of-doors         four           two
aspiration
std          12509.847826  12582.931507
turbo        17450.782609  14138.846154
```

```
aspiration  body-style
std         convertible    21890.500000
            hardtop        21356.000000
            hatchback       9312.089286
            sedan          13785.210526
            wagon          10973.600000
turbo       hardtop        28176.000000
            hatchback      12969.083333
            sedan          17307.833333
            wagon          17965.400000
Name: price, dtype: float64

Pivot Table
                price
body-style convertible  hardtop     hatchback         sedan    wag
on
aspiration
std            21890.5  21356.0   9312.089286  13785.210526  10973
```

```
.6
turbo                -  28176.0  12969.083333  17307.833333  17965
.4



aspiration  drive-wheels
std         4wd              9829.166667
            fwd              8724.029412
            rwd             19660.245614
turbo       4wd             11476.500000
            fwd             12564.562500
            rwd             20065.944444
Name: price, dtype: float64

Pivot Table
                     price
drive-wheels           4wd           fwd           rwd
aspiration
std            9829.166667   8724.029412  19660.245614
turbo         11476.500000  12564.562500  20065.944444



aspiration  engine-location
std         front              12135.037037
            rear               34528.000000
turbo       front              16254.805556
Name: price, dtype: float64

Pivot Table
                        price
engine-location         front   rear
aspiration
std              12135.037037  34528
turbo            16254.805556      -



aspiration  engine-type
std         dohc           18062.700000
            l              13066.000000
            ohc            10572.091667
            ohcf           14086.615385
            ohcv           25548.333333
            rotor          13020.000000
turbo       dohc           18385.000000
            l              16189.166667
            ohc            16344.640000
            ohcf           11476.500000
            ohcv           19699.000000
Name: price, dtype: float64
```

```
Pivot Table
               price
\
engine-type     dohc             l           ohc          ohcf
ohcv
aspiration
std          18062.7  13066.000000  10572.091667  14086.615385  25
548.333333
turbo        18385.0  16189.166667  16344.640000  11476.500000  19
699.000000


engine-type  rotor
aspiration
std          13020
turbo            -



aspiration  num-of-cylinders
std         eight               38900.000000
            five                16525.000000
            four                 9469.132812
            six                 23907.045455
            three                5151.000000
            twelve              36000.000000
            two                 13020.000000
turbo       five                27490.200000
            four                13984.586207
            six                 21084.500000
Name: price, dtype: float64

Pivot Table
                  price
\
num-of-cylinders  eight     five          four           six three
twelve
aspiration
std               38900  16525.0   9469.132812  23907.045455  5151
36000
turbo                 -  27490.2  13984.586207  21084.500000     -
-


num-of-cylinders    two
aspiration
std               13020
turbo                 -



aspiration  fuel-system
std         1bbl           7555.545455
```

```
            2bbl            7433.203125
            4bbl           12145.000000
            idi             9670.571429
            mpfi           17771.384615
            spdi            9279.000000
            spfi           11048.000000
turbo       idi            19159.153846
            mfi            12964.000000
            mpfi           16678.928571
            spdi           11204.375000
Name: price, dtype: float64

Pivot Table
               price
\
fuel-system     1bbl    2bbl   4bbl           idi    mfi
mpfi
aspiration
std          7555.55  7433.2  12145   9670.571429      -  17771.38
4615
turbo              -       -      -  19159.153846  12964  16678.92
8571


fuel-system       spdi   spfi
aspiration
std            9279.000  11048
turbo         11204.375      -



aspiration  horsepower-binned
std         High                 29143.312500
            Low                   8629.186916
            Medium               15703.512195
turbo       High                 18483.857143
            Low                  14127.875000
            Medium               16322.047619
Name: price, dtype: float64

Pivot Table
                          price
horsepower-binned          High            Low        Medium
aspiration
std                29143.312500   8629.186916  15703.512195
turbo              18483.857143  14127.875000  16322.047619



num-of-doors  body-style
four          hatchback       8372.000000
              sedan          14490.687500
              wagon          12371.960000
```

```
two           convertible    21890.500000
              hardtop        22208.500000
              hatchback      10230.793103
              sedan          14283.000000
Name: price, dtype: float64

Pivot Table
                  price
body-style   convertible  hardtop     hatchback       sedan  wagon
num-of-doors
four                   -        -   8372.000000  14490.6875  12372
two              21890.5  22208.5  10230.793103  14283.0000      -



num-of-doors  drive-wheels
four          4wd             10617.857143
              fwd              9789.072464
              rwd             20577.000000
two           4wd              7603.000000
              fwd              8478.326531
              rwd             18869.944444
Name: price, dtype: float64

Pivot Table
                    price
drive-wheels          4wd          fwd           rwd
num-of-doors
four         10617.857143  9789.072464  20577.000000
two           7603.000000  8478.326531  18869.944444



num-of-doors  engine-location
four          front              13498.034783
two           front              12033.433735
              rear               34528.000000
Name: price, dtype: float64

Pivot Table
                       price
engine-location        front   rear
num-of-doors
four            13498.034783      -
two             12033.433735  34528



num-of-doors  engine-type
four          dohc           23572.000000
              l              15489.090909
              ohc            12420.083333
              ohcf            9191.222222
```

```
                ohcv           23004.333333
two             dohc           14219.571429
                l               5151.000000
                ohc            10393.114754
                ohcf           20559.666667
                ohcv           26893.285714
                rotor          13020.000000
Name: price, dtype: float64

Pivot Table
                     price                                          
\
engine-type           dohc            l          ohc          oh
cf
num-of-doors                                                        
four          23572.000000  15489.090909  12420.083333   9191.2222
22
two           14219.571429   5151.000000  10393.114754  20559.6666
67


engine-type           ohcv  rotor
num-of-doors                     
four          23004.333333      -
two           26893.285714  13020



num-of-doors  num-of-cylinders
four          eight               37572.000000
              five                22081.250000
              four                10897.586957
              six                 22915.538462
two           eight               40228.000000
              five                21713.000000
              four                 9461.907692
              six                 24565.636364
              three                5151.000000
              twelve              36000.000000
              two                 13020.000000
Name: price, dtype: float64

Pivot Table
                    price                                          
\
num-of-cylinders    eight      five          four           six th
ree twelve
num-of-doors                                                      
four              37572.0  22081.25  10897.586957  22915.538462   
-      -
two               40228.0  21713.00   9461.907692  24565.636364  5
151  36000
```

```
num-of-cylinders    two
num-of-doors
four                  -
two               13020
```

```
num-of-doors  fuel-system
four          1bbl            8432.500000
              2bbl            7807.864865
              idi            16100.764706
              mpfi           17043.309091
              spdi            9279.000000
two           1bbl            7054.428571
              2bbl            6919.777778
              4bbl           12145.000000
              idi            14350.000000
              mfi            12964.000000
              mpfi           18440.297297
              spdi           11479.428571
              spfi           11048.000000
Name: price, dtype: float64

Pivot Table
                    price
\
fuel-system          1bbl         2bbl   4bbl           idi    mfi
num-of-doors
four          8432.500000  7807.864865      -  16100.764706      -
two           7054.428571  6919.777778  12145  14350.000000  12964


fuel-system           mpfi          spdi   spfi
num-of-doors
four          17043.309091   9279.000000      -
two           18440.297297  11479.428571  11048
```

```
num-of-doors  horsepower-binned
four          High                 25715.909091
              Low                   9743.577465
              Medium               17503.181818
two           High                 26067.083333
              Low                   7830.727273
              Medium               14103.517241
Name: price, dtype: float64

Pivot Table
                          price
horsepower-binned          High          Low        Medium
num-of-doors
```

```
four               25715.909091  9743.577465  17503.181818
two                26067.083333  7830.727273  14103.517241
```

```
body-style   drive-wheels
convertible  fwd             11595.000000
             rwd             23949.600000
hardtop      fwd              8249.000000
             rwd             24202.714286
hatchback    4wd              7603.000000
             fwd              8396.387755
             rwd             14337.777778
sedan        4wd             12647.333333
             fwd              9811.800000
             rwd             21711.833333
wagon        4wd              9095.750000
             fwd              9997.333333
             rwd             16994.222222
Name: price, dtype: float64

Pivot Table
                 price
drive-wheels       4wd           fwd           rwd
body-style
convertible          -  11595.000000  23949.600000
hardtop              -   8249.000000  24202.714286
hatchback         7603   8396.387755  14337.777778
sedan          12647.3   9811.800000  21711.833333
wagon          9095.75   9997.333333  16994.222222
```

```
body-style   engine-location
convertible  front              18863.000000
             rear               37028.000000
hardtop      front              18518.666667
             rear               33278.000000
hatchback    front               9957.441176
sedan        front              14459.755319
wagon        front              12371.960000
Name: price, dtype: float64

Pivot Table
                         price
engine-location          front   rear
body-style
convertible       18863.000000  37028
hardtop           18518.666667  33278
hatchback          9957.441176      -
sedan             14459.755319      -
wagon             12371.960000      -
```

```
body-style   engine-type
convertible  dohc           14997.500000
             ohc            14632.000000
             ohcf           37028.000000
             ohcv           35056.000000
hardtop      ohc            13142.400000
             ohcf           33278.000000
             ohcv           45400.000000
hatchback    dohc           15061.000000
             l               5151.000000
             ohc             9001.153846
             ohcf            6591.333333
             ohcv           17949.250000
             rotor          13020.000000
sedan        dohc           22281.600000
             l              15758.571429
             ohc            13134.070423
             ohcf            9070.600000
             ohcv           26604.500000
wagon        dohc           15750.000000
             l              15017.500000
             ohc            12114.133333
             ohcf            9342.000000
             ohcv           14399.000000
Name: price, dtype: float64

Pivot Table
               price
engine-type     dohc        l          ohc          ohcf      ohc
v  rotor
body-style
convertible  14997.5        -  14632.000000  37028.000000  35056.0
0      -
hardtop            -        -  13142.400000  33278.000000  45400.0
0      -
hatchback      15061     5151   9001.153846   6591.333333  17949.2
5  13020
sedan        22281.6  15758.6  13134.070423   9070.600000  26604.5
0      -
wagon          15750  15017.5  12114.133333   9342.000000  14399.0
0      -



body-style   num-of-cylinders
convertible  eight               35056.000000
             four                14814.750000
             six                 37028.000000
hardtop      eight               45400.000000
             five                28176.000000
             four                 9384.000000
             six                 33278.000000
hatchback    four                 9044.245614
             six                 17392.166667
             three                5151.000000
             two                 13020.000000
sedan        eight               37572.000000
             five                20676.000000
             four                10891.591549
             six                 25387.538462
             twelve              36000.000000
wagon        five                23584.000000
             four                11046.761905
             six                 15074.500000
Name: price, dtype: float64

Pivot Table
                  price
num-of-cylinders  eight   five          four           six three t
welve    two
body-style
convertible       35056      -  14814.750000  37028.000000     -
-      -
hardtop           45400  28176   9384.000000  33278.000000     -
-      -
hatchback             -      -   9044.245614  17392.166667  5151
-  13020
sedan             37572  20676  10891.591549  25387.538462     -
36000      -
wagon                 -  23584  11046.761905  15074.500000     -
-      -



body-style   fuel-system
convertible  mpfi          21890.500000
hardtop      2bbl           8249.000000
             idi           28176.000000
             mpfi          23540.500000
hatchback    1bbl           7054.428571
             2bbl           6979.678571
             4bbl          12145.000000
             idi            7788.000000
             mfi           12964.000000
             mpfi          14185.150000
             spdi          11479.428571
             spfi          11048.000000
sedan        1bbl           8811.666667
             2bbl           7684.038462
             idi           14774.400000
             mpfi          18600.479167
             spdi           9279.000000
wagon        1bbl           7295.000000
             2bbl           8028.888889
             idi            19727.666667
             mpfi           14213.416667
Name: price, dtype: float64

Pivot Table
               price                                                   
\
fuel-system     1bbl     2bbl   4bbl      idi    mfi          mpfi     
spdi
body-style                                                             
convertible        -        -      -        -      -  21890.500000     
-
hardtop            -     8249      -    28176      -  23540.500000     
-
hatchback    7054.43  6979.68  12145     7788  12964  14185.150000  
11479.4
sedan        8811.67  7684.04      -  14774.4      -  18600.479167     
9279
wagon           7295  8028.89      -  19727.7      -  14213.416667     
-


fuel-system   spfi
body-style        
convertible      -
hardtop          -
hatchback    11048
sedan            -
wagon            -



body-style   horsepower-binned
convertible  High                 37028.000000
             Low                  11595.000000
             Medium               20680.000000
hardtop      High                 37318.666667
             Low                   8249.000000
             Medium               14365.750000
hatchback    High                 17500.857143
             Low                   7704.627907
             Medium               12405.611111
sedan        High                 28949.000000
             Low                   9686.851852
             Medium               17608.172414
wagon        High                 17350.000000
             Low                  10132.062500
             Medium               16069.428571
Name: price, dtype: float64

Pivot Table
                          price                          
horsepower-binned          High             Low        Medium
```

```
body-style
convertible        37028.000000  11595.000000  20680.000000
hardtop            37318.666667   8249.000000  14365.750000
hatchback          17500.857143   7704.627907  12405.611111
sedan              28949.000000   9686.851852  17608.172414
wagon              17350.000000  10132.062500  16069.428571
```

```
drive-wheels  engine-location
4wd           front              10241.000000
fwd           front               9244.779661
rwd           front              19142.180556
              rear               34528.000000
Name: price, dtype: float64

Pivot Table
                        price
engine-location         front   rear
drive-wheels
4wd              10241.000000      -
fwd               9244.779661      -
rwd              19142.180556  34528
```

```
drive-wheels  engine-type
4wd           ohc             11375.333333
              ohcf             9560.400000
fwd           dohc            18385.000000
              l                5151.000000
              ohc              9074.980952
              ohcf             7813.285714
              ohcv            13799.000000
rwd           dohc            18062.700000
              l               15489.090909
              ohc             18655.891892
              ohcf            34528.000000
              ohcv            28488.200000
              rotor           13020.000000
Name: price, dtype: float64

Pivot Table
                price
engine-type      dohc        l           ohc          ohcf     ohc
v  rotor
drive-wheels
4wd                 -        -  11375.333333   9560.400000
-      -
fwd             18385     5151   9074.980952   7813.285714    1379
9      -
rwd           18062.7  15489.1  18655.891892  34528.000000  28488.
2  13020
```

```
drive-wheels  num-of-cylinders
4wd           five                17450.000000
              four                 9211.142857
fwd           five                17810.000000
              four                 8764.091743
              six                 13799.000000
              three                5151.000000
rwd           eight               38900.000000
              five                28394.000000
              four                14581.414634
              six                 25082.238095
              twelve              36000.000000
              two                 13020.000000
Name: price, dtype: float64

Pivot Table
                  price
num-of-cylinders  eight     five          four      six three twel
ve    two
drive-wheels
4wd                   -  17450.0   9211.142857        -     -
-      -
fwd                   -  17810.0   8764.091743    13799  5151
-      -
rwd               38900  28394.0  14581.414634  25082.2     -  360
00  13020



drive-wheels  fuel-system
4wd           2bbl            8305.000000
              mpfi           13467.666667
fwd           1bbl            7555.545455
              2bbl            7341.410714
              idi             9265.333333
              mfi            12964.000000
              mpfi           12550.060606
              spdi           10768.750000
rwd           2bbl            7693.666667
              4bbl           12145.000000
              idi            21215.909091
              mpfi           20805.678571
              spdi           12764.000000
              spfi           11048.000000
Name: price, dtype: float64

Pivot Table
                price
\
fuel-system      1bbl         2bbl   4bbl      idi    mfi
```

```
mpfi
drive-wheels
4wd                 -  8305.000000      -        -      -  13467.6
66667
fwd           7555.55  7341.410714      -  9265.33  12964  12550.0
60606
rwd                 -  7693.666667  12145  21215.9      -  20805.6
78571


fuel-system      spdi   spfi
drive-wheels
4wd                 -      -
fwd           10768.8      -
rwd             12764  11048



drive-wheels  horsepower-binned
4wd           Low                    8305.000000
              Medium                13467.666667
fwd           High                  18385.000000
              Low                    8003.644444
              Medium                12837.923077
rwd           High                  26614.761905
              Low                   13724.650000
              Medium                18558.121212
Name: price, dtype: float64

Pivot Table
                     price
horsepower-binned     High           Low        Medium
drive-wheels
4wd                      -   8305.000000  13467.666667
fwd                  18385   8003.644444  12837.923077
rwd                26614.8  13724.650000  18558.121212



engine-location  engine-type
front            dohc           18116.416667
                 l              14627.583333
                 ohc            11567.358621
                 ohcf            8541.250000
                 ohcv           25098.384615
                 rotor          13020.000000
rear             ohcf           34528.000000
Name: price, dtype: float64

Pivot Table
                   price
engine-type         dohc        l      ohc      ohcf     ohcv  rot
or
```

```
engine-location
front            18116.4  14627.6  11567.4   8541.25  25098.4  130
20
rear                   -        -        -  34528.00        -
-



engine-location  num-of-cylinders
front            eight               38900.000000
                 five                22007.600000
                 four                10303.197452
                 six                 22120.952381
                 three                5151.000000
                 twelve              36000.000000
                 two                 13020.000000
rear             six                 34528.000000
Name: price, dtype: float64

Pivot Table
                  price
num-of-cylinders  eight     five     four           six three twel
ve    two
engine-location
front             38900  22007.6  10303.2  22120.952381  5151  360
00  13020
rear                  -        -        -  34528.000000     -
-      -



engine-location  fuel-system
front            1bbl            7555.545455
                 2bbl            7433.203125
                 4bbl           12145.000000
                 idi            15838.150000
                 mfi            12964.000000
                 mpfi           17034.707865
                 spdi           10990.444444
                 spfi           11048.000000
rear             mpfi           34528.000000
Name: price, dtype: float64

Pivot Table
                   price
\
fuel-system         1bbl    2bbl   4bbl      idi    mfi          m
pfi
engine-location
front            7555.55  7433.2  12145  15838.1  12964  17034.707
865
rear                   -       -      -        -      -  34528.000
000
```

```
fuel-system         spdi   spfi
engine-location
front            10990.4  11048
rear                   -      -
```

```
engine-location  horsepower-binned
front            High                 24604.800000
                 Low                   9011.704348
                 Medium               15913.016129
rear             High                 34528.000000
Name: price, dtype: float64

Pivot Table
                     price
horsepower-binned     High     Low Medium
engine-location
front              24604.8  9011.7  15913
rear               34528.0       -      -
```

```
engine-type  num-of-cylinders
dohc         four                14266.833333
             six                 21966.000000
l            four                15489.090909
             three                5151.000000
ohc          five                22007.600000
             four                 9836.921875
             six                 28295.000000
ohcf         four                 8541.250000
             six                 34528.000000
ohcv         eight               38900.000000
             six                 16834.875000
             twelve              36000.000000
rotor        two                 13020.000000
Name: price, dtype: float64

Pivot Table
                  price
num-of-cylinders  eight     five     four      six three twelve
two
engine-type
dohc                  -        -  14266.8    21966     -      -
-
l                     -        -  15489.1        -  5151      -
-
ohc                   -  22007.6  9836.92    28295     -      -
-
ohcf                  -        -  8541.25    34528     -      -
```

```
-
ohcv              38900        -        -  16834.9     -  36000
-
rotor                 -        -        -        -     -      -  1
3020



engine-type  fuel-system
dohc         mpfi           18116.416667
l            2bbl            5151.000000
             idi            15797.000000
             mpfi           15232.500000
ohc          1bbl            7555.545455
             2bbl            7476.181818
             idi            15851.866667
             mfi            12964.000000
             mpfi           15514.377358
             spdi           10990.444444
             spfi           11048.000000
ohcf         2bbl            7423.000000
             mpfi           20956.428571
ohcv         mpfi           25098.384615
rotor        4bbl           12145.000000
             mpfi           15645.000000
Name: price, dtype: float64

Pivot Table
               price
\
fuel-system     1bbl     2bbl   4bbl      idi    mfi          mpfi
spdi
engine-type
dohc               -        -      -        -      -  18116.416667
-
l                  -     5151      -    15797      -  15232.500000
-
ohc          7555.55  7476.18      -  15851.9  12964  15514.377358
10990.4
ohcf               -     7423      -        -      -  20956.428571
-
ohcv               -        -      -        -      -  25098.384615
-
rotor              -        -  12145        -      -  15645.000000
-


fuel-system   spfi
engine-type
dohc             -
l                -
ohc          11048
ohcf             -
```

```
ohcv            -
rotor           -



engine-type  horsepower-binned
dohc         High                 21070.750000
             Medium               12207.750000
l            Low                  14307.363636
             Medium               18150.000000
ohc          High                 25981.857143
             Low                   8384.483516
             Medium               15583.106383
ohcf         High                 34528.000000
             Low                   7954.200000
             Medium               11476.500000
ohcv         High                 28331.400000
             Medium               21231.714286
rotor        Low                  12145.000000
             Medium               15645.000000
Name: price, dtype: float64

Pivot Table
                     price
horsepower-binned     High      Low        Medium
engine-type
dohc               21070.8        -  12207.750000
l                        -  14307.4  18150.000000
ohc                25981.9  8384.48  15583.106383
ohcf                 34528   7954.2  11476.500000
ohcv               28331.4        -  21231.714286
rotor                    -    12145  15645.000000



num-of-cylinders  fuel-system
eight             mpfi           38900.000000
five              idi            28394.000000
                  mpfi           17750.000000
four              1bbl            7555.545455
                  2bbl            7469.428571
                  idi            12047.800000
                  mfi            12964.000000
                  mpfi           13338.140351
                  spdi           10990.444444
                  spfi           11048.000000
six               idi            22470.000000
                  mpfi           23724.086957
three             2bbl            5151.000000
twelve            mpfi           36000.000000
two               4bbl           12145.000000
                  mpfi           15645.000000
Name: price, dtype: float64
```

```
Pivot Table
                    price
\
fuel-system          1bbl     2bbl   4bbl      idi    mfi     mpfi
spdi
num-of-cylinders
eight                   -        -      -        -      -    38900
-
five                    -        -      -    28394      -    17750
-
four              7555.55  7469.43      -  12047.8  12964  13338.1
10990.4
six                     -        -      -    22470      -  23724.1
-
three                   -     5151      -        -      -        -
-
twelve                  -        -      -        -      -    36000
-
two                     -        -  12145        -      -    15645
-


fuel-system        spfi
num-of-cylinders
eight                 -
five                  -
four              11048
six                   -
three                 -
twelve                -
two                   -



num-of-cylinders  horsepower-binned
eight             High                 43180.000000
                  Medium               34620.000000
five              Medium               22007.600000
four              High                 18281.333333
                  Low                   8961.801802
                  Medium               12828.850000
six               High                 26642.133333
                  Medium               18721.333333
three             Low                   5151.000000
two               Low                  12145.000000
                  Medium               15645.000000
Name: price, dtype: float64

Pivot Table
                     price
horsepower-binned     High     Low   Medium
num-of-cylinders
```

```
eight                 43180       -    34620
five                      -       -  22007.6
four                18281.3  8961.8  12828.9
six                 26642.1       -  18721.3
three                     -    5151        -
two                       -   12145    15645
```

```
fuel-system  horsepower-binned
1bbl         Low                   7555.545455
2bbl         Low                   7433.203125
4bbl         Low                  12145.000000
idi          Low                  12047.800000
             Medium               27209.200000
mfi          Medium               12964.000000
mpfi         High                 25899.130435
             Low                  11871.904762
             Medium               15716.659574
spdi         Medium               10990.444444
spfi         Low                  11048.000000
Name: price, dtype: float64

Pivot Table
                     price
horsepower-binned     High      Low   Medium
fuel-system
1bbl                     -  7555.55        -
2bbl                     -   7433.2        -
4bbl                     -    12145        -
idi                      -  12047.8  27209.2
mfi                      -        -    12964
mpfi               25899.1  11871.9  15716.7
spdi                     -        -  10990.4
spfi                     -    11048        -
```

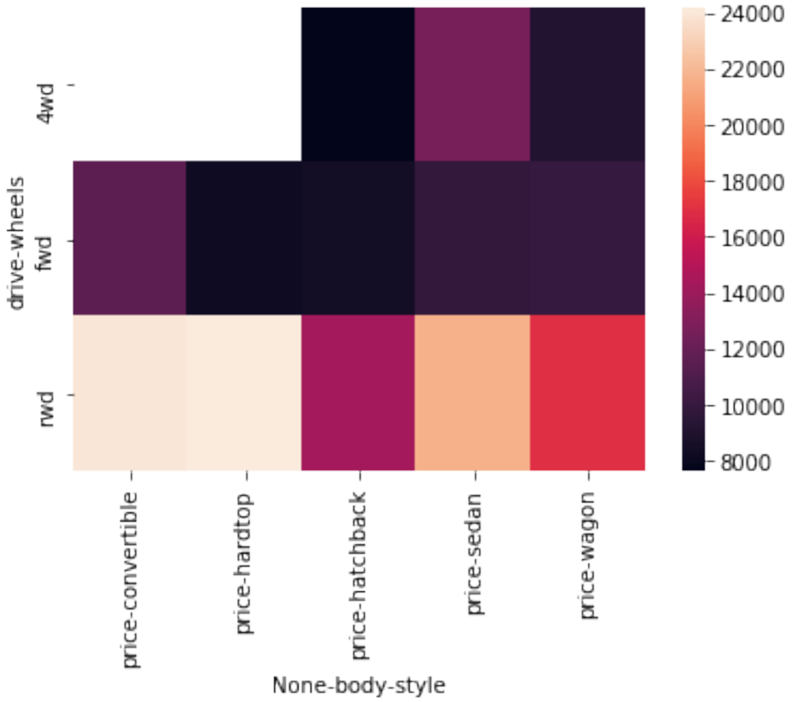
Observations :- We can see that there are no cars with medium or low horsepower which have their engine in rear. These are majorly the sports cars of segment. We also see that of all the segments, the cars having engine in the front and with low horsepower have the lowest average price of any car.

In [43]:

```
sns.heatmap(pivot_table)
```

Out[43]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x7fed5d10bb10>
```



The heatmap plots the target variable (price) proportional to colour with respect to the variables 'drive-wheel' and 'body-style' in the vertical and horizontal axis respectively. This allows us to visualize how the price is related to 'drive-wheel' and 'body-style'.Using Pearson coeffecientThe Pearson Correlation measures the linear dependence between two variables X and Y. The resulting coefficient is a value between -1 and 1 inclusive, where: 1: Total positive linear correlation. 0: No linear correlation, the two variables most likely do not affect each other. -1: Total negative linear correlation.Wheel-base vs Price

In [45]:

```
pearson_coeff, p_val = ss.pearsonr(cars['wheel-base'], cars['price'])
print(pearson_coeff, p_val)
```

```
0.584641822265508 8.076488270733218e-20
```

Since the p-value is < 0.001, the correlation between wheel-base and price is statistically significant, although the linear relationship isn't extremely strong (~0.585)Since ANOVA analyzes the difference between different groups of the same variable, the groupby function will come in handy. Because the ANOVA algorithm averages the data automatically, we do not need to take the average before hand. Let's see if different types 'drive-wheels' impact 'price', we group the data.

In [47]:

```
a = cars[['drive-wheels', 'body-style','price']]
a = a[['drive-wheels', 'price']].groupby(['drive-wheels'])
a
f_val, p_val = stats.f_oneway(a.get_group('fwd')['price'],
                              a.get_group('4wd')['price'],
                              a.get_group('rwd')['price'])
print(f_val, p_val)
```

```
67.95406500780398 3.3945443577151245e-23
```

This is a great result, with a large F test score showing a strong correlation and a P value of almost 0 implying almost certain statistical significance.Separately: ANOVA RESULTS

In [51]:

```
print("fwd and rwd")
f_val, p_val = stats.f_oneway(a.get_group('fwd')['price'], a.get_group('rwd')[
'price'])

print( "ANOVA results: F=", f_val, ", P =", p_val )

print("4wd and rwd")
f_val, p_val = stats.f_oneway(a.get_group('4wd')['price'], a.get_group('rwd')[
'price'])

print( "ANOVA results: F=", f_val, ", P =", p_val)

print("4wd and fwd")
f_val, p_val = stats.f_oneway(a.get_group('4wd')['price'], a.get_group('fwd')[
'price'])

print("ANOVA results: F=", f_val, ", P =", p_val)
```

```
fwd and rwd
ANOVA results: F= 130.5533160959111 , P = 2.2355306355677845e-23
4wd and rwd
ANOVA results: F= 8.580681368924756 , P = 0.004411492211225333
4wd and fwd
ANOVA results: F= 0.665465750252303 , P = 0.41620116697845666
```

We now have a better idea of what our data looks like and which variables are important to take into account when predicting the car price. We have narrowed it down to the following variables: Continuous numerical variables: Length Width Curb-weight Engine-size Horsepower City-mpg Highway-mpg Wheel-base Bore Categorical variables: Drive-wheels