```
1 import numpy as np
2 import pandas as pd
3 import matplotlib.pyplot as plt
4
5 from sklearn.model_selection import train_test_split
6
```

```
--NORMAL--
```

```
1 from sklearn.metrics import mean_squared_error, r2_score
2 #Import Data from Input
3 df= pd.read_csv(r"C:\\Users\\shiny\\Downloads\\Automobile_data.csv")
```

```
1 df.head()
```

	symboling	normalized-losses	make	fuel-type	aspiration	num-of-doors	body-style	drive-wheels	engine-location
0	3	?	alfa-romero	gas	std	two	convertible	rwd	front
1	3	?	alfa-romero	gas	std	two	convertible	rwd	front
2	1	?	alfa-romero	gas	std	two	hatchback	rwd	front
3	2	164	audi	gas	std	four	sedan	fwd	front
4	2	164	audi	gas	std	four	sedan	4wd	front

```
1 df.shape
2
```

```
(205, 26)
```

```
1 df.columns
```

```
Index(['symboling', 'normalized-losses', 'make', 'fuel-type', 'aspiration',
       'num-of-doors', 'body-style', 'drive-wheels', 'engine-location',
       'wheel-base', 'length', 'width', 'height', 'curb-weight', 'engine-type',
       'num-of-cylinders', 'engine-size', 'fuel-system', 'bore', 'stroke',
       'compression-ratio', 'horsepower', 'peak-rpm', 'city-mpg',
       'highway-mpg', 'price'],
      dtype='object')
```

```
1 df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 205 entries, 0 to 204
Data columns (total 26 columns):
 #   Column             Non-Null Count  Dtype
---  ------             --------------  -----
 0   symboling          205 non-null    int64
 1   normalized-losses  205 non-null    object
 2   make               205 non-null    object
 3   fuel-type          205 non-null    object
 4   aspiration         205 non-null    object
 5   num-of-doors       205 non-null    object
 6   body-style         205 non-null    object
 7   drive-wheels       205 non-null    object
 8   engine-location    205 non-null    object
 9   wheel-base         205 non-null    float64
 10  length             205 non-null    float64
 11  width              205 non-null    float64
 12  height             205 non-null    float64
 13  curb-weight        205 non-null    int64
 14  engine-type        205 non-null    object
 15  num-of-cylinders   205 non-null    object
 16  engine-size        205 non-null    int64
 17  fuel-system        205 non-null    object
 18  bore               205 non-null    object
 19  stroke             205 non-null    object
```

```
 20  compression-ratio  205 non-null    float64
 21  horsepower         205 non-null    object
 22  peak-rpm           205 non-null    object
 23  city-mpg           205 non-null    int64
 24  highway-mpg        205 non-null    int64
 25  price              205 non-null    object
dtypes: float64(5), int64(5), object(16)
memory usage: 41.8+ KB
```

```
df = df.rename({"normalized-losses":"normalizedlosses"}, axis='columns')
```

```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 205 entries, 0 to 204
Data columns (total 26 columns):
 #   Column             Non-Null Count  Dtype
---  ------             --------------  -----
 0   symboling          205 non-null    int64
 1   normalizedlosses   205 non-null    object
 2   make               205 non-null    object
 3   fuel-type          205 non-null    object
 4   aspiration         205 non-null    object
 5   num-of-doors       205 non-null    object
 6   body-style         205 non-null    object
 7   drive-wheels       205 non-null    object
 8   engine-location    205 non-null    object
 9   wheel-base         205 non-null    float64
 10  length             205 non-null    float64
 11  width              205 non-null    float64
 12  height             205 non-null    float64
 13  curb-weight        205 non-null    int64
 14  engine-type        205 non-null    object
 15  num-of-cylinders   205 non-null    object
 16  engine-size        205 non-null    int64
 17  fuel-system        205 non-null    object
 18  bore               205 non-null    object
 19  stroke             205 non-null    object
 20  compression-ratio  205 non-null    float64
 21  horsepower         205 non-null    object
 22  peak-rpm           205 non-null    object
 23  city-mpg           205 non-null    int64
 24  highway-mpg        205 non-null    int64
 25  price              205 non-null    object
dtypes: float64(5), int64(5), object(16)
memory usage: 41.8+ KB
```

```
df.normalizedlosses.unique()
```

```
array(['?', '164', '158', '192', '188', '121', '98', '81', '118', '148',
       '110', '145', '137', '101', '78', '106', '85', '107', '104', '113',
       '150', '129', '115', '93', '142', '161', '153', '125', '128',
       '122', '103', '168', '108', '194', '231', '119', '154', '74',
       '186', '83', '102', '89', '87', '77', '91', '134', '65', '197',
       '90', '94', '256', '95'], dtype=object)
```

```
df = df[df.normalizedlosses != "?"]
df.normalizedlosses = df.normalizedlosses.astype("float")
```

```
df.horsepower.unique()
```

```
array(['102', '115', '110', '140', '101', '121', '48', '70', '68', '88',
       '145', '58', '76', '60', '86', '100', '176', '135', '84', '120',
       '123', '155', '116', '69', '55', '97', '152', '160', '200', '95',
       '142', '143', '73', '82', '94', '111', '62', '56', '112', '92',
       '161', '156', '52', '85', '90', '114', '162', '134', '106'],
      dtype=object)
```

```
df = df[df.horsepower != "?"]
df.horsepower = df.horsepower.astype("int")
```

```
df.stroke.unique()
```

```
array(['3.4', '2.8', '3.19', '3.03', '3.11', '3.23', '3.39', '3.46',
       '3.9', '3.41', '3.07', '3.58', '4.17', '3.15', '?', '3.16', '3.64',
```

```
       '3.1', '3.29', '3.47', '3.27', '3.52', '2.19', '3.21', '2.07',
       '2.36', '2.64', '3.35', '3.08', '3.5', '3.54', '2.87'],
      dtype=object)
```

```
df = df[df.stroke != "?"]
df.stroke = df.stroke.astype("float")
```

```
df = df.rename({"peak-rpm":"peakrpm"}, axis='columns')
```

```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Int64Index: 160 entries, 3 to 204
Data columns (total 26 columns):
 #   Column             Non-Null Count  Dtype  
---  ------             --------------  -----  
 0   symboling          160 non-null    int64  
 1   normalizedlosses   160 non-null    float64
 2   make               160 non-null    object 
 3   fuel-type          160 non-null    object 
 4   aspiration         160 non-null    object 
 5   num-of-doors       160 non-null    object 
 6   body-style         160 non-null    object 
 7   drive-wheels       160 non-null    object 
 8   engine-location    160 non-null    object 
 9   wheel-base         160 non-null    float64
 10  length             160 non-null    float64
 11  width              160 non-null    float64
 12  height             160 non-null    float64
 13  curb-weight        160 non-null    int64  
 14  engine-type        160 non-null    object 
 15  num-of-cylinders   160 non-null    object 
 16  engine-size        160 non-null    int64  
 17  fuel-system        160 non-null    object 
 18  bore               160 non-null    object 
 19  stroke             160 non-null    float64
 20  compression-ratio  160 non-null    float64
 21  horsepower         160 non-null    int32  
 22  peakrpm            160 non-null    object 
 23  city-mpg           160 non-null    int64  
 24  highway-mpg        160 non-null    int64  
 25  price              160 non-null    object 
dtypes: float64(7), int32(1), int64(5), object(13)
memory usage: 33.1+ KB
```

```
df.peakrpm.unique()
```

```
array(['5500', '5800', '4250', '5100', '5400', '5000', '4800', '6000',
       '4750', '4350', '5200', '4150', '5600', '5250', '4900', '4400',
       '4500', '6600', '4200', '5300'], dtype=object)
```

```
df = df[df.peakrpm != "?"]
df.peakrpm = df.peakrpm.astype("int")
```

```
df.price.unique()
```

```
array(['13950', '17450', '17710', '23875', '16430', '16925', '20970',
       '21105', '5151', '6295', '6575', '5572', '6377', '7957', '6229',
       '6692', '7609', '8558', '8921', '12964', '6479', '6855', '5399',
       '6529', '7129', '7295', '7895', '9095', '8845', '10295', '12945',
       '10345', '32250', '5195', '6095', '6795', '6695', '7395', '8495',
       '10595', '10245', '11245', '18280', '25552', '28248', '28176',
       '31600', '35056', '5389', '6189', '6669', '7689', '9959', '8499',
       '6989', '8189', '9279', '5499', '7099', '6649', '6849', '7349',
       '7299', '7799', '7499', '7999', '8249', '8949', '9549', '13499',
       '14399', '17199', '19699', '18399', '11900', '13200', '15580',
       '16900', '16630', '17950', '18150', '22018', '11850', '12170',
       '15040', '15510', '18620', '5118', '7053', '7603', '7126', '7775',
       '9960', '9233', '11259', '7463', '10198', '8013', '11694', '5348',
       '6338', '6488', '6918', '7898', '8778', '6938', '7198', '7788',
       '7738', '8358', '9258', '8058', '8238', '9298', '9538', '8449',
       '9639', '9989', '11199', '11549', '17669', '8948', '10698', '9988',
       '10898', '11248', '16558', '15998', '15690', '7975', '7995',
       '8195', '9495', '9995', '9980', '12940', '13415', '15985', '16515',
       '18420', '18950', '16845', '19045', '21485', '22470', '22625'],
      dtype=object)
```

```
1 df = df[df.price != "?"]
2 df.price = df.price.astype("int")
```

```
1 df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Int64Index: 160 entries, 3 to 204
Data columns (total 26 columns):
 #   Column             Non-Null Count  Dtype
---  ------             --------------  -----
 0   symboling          160 non-null    int64
 1   normalizedlosses   160 non-null    float64
 2   make               160 non-null    object
 3   fuel-type          160 non-null    object
 4   aspiration         160 non-null    object
 5   num-of-doors       160 non-null    object
 6   body-style         160 non-null    object
 7   drive-wheels       160 non-null    object
 8   engine-location    160 non-null    object
 9   wheel-base         160 non-null    float64
 10  length             160 non-null    float64
 11  width              160 non-null    float64
 12  height             160 non-null    float64
 13  curb-weight        160 non-null    int64
 14  engine-type        160 non-null    object
 15  num-of-cylinders   160 non-null    object
 16  engine-size        160 non-null    int64
 17  fuel-system        160 non-null    object
 18  bore               160 non-null    object
 19  stroke             160 non-null    float64
 20  compression-ratio  160 non-null    float64
 21  horsepower         160 non-null    int32
 22  peakrpm            160 non-null    int32
 23  city-mpg           160 non-null    int64
 24  highway-mpg        160 non-null    int64
 25  price              160 non-null    int32
dtypes: float64(7), int32(3), int64(5), object(11)
memory usage: 31.9+ KB
```

```
1 df.describe()
2
```

	symboling	normalizedlosses	wheel-base	length	width	height	
count	160.000000	160.000000	160.000000	160.000000	160.000000	160.000000	160.
mean	0.737500	121.300000	98.235625	172.319375	65.596250	53.878750	2459.
std	1.189511	35.602417	5.163763	11.548860	1.946999	2.276608	480.
min	-2.000000	65.000000	86.600000	141.100000	60.300000	49.400000	1488.
25%	0.000000	94.000000	94.500000	165.525000	64.000000	52.000000	2073.
50%	1.000000	114.000000	96.900000	172.200000	65.400000	54.100000	2338.
75%	2.000000	148.000000	100.600000	177.800000	66.500000	55.500000	2808.

```
1 df.isnull().sum()
```

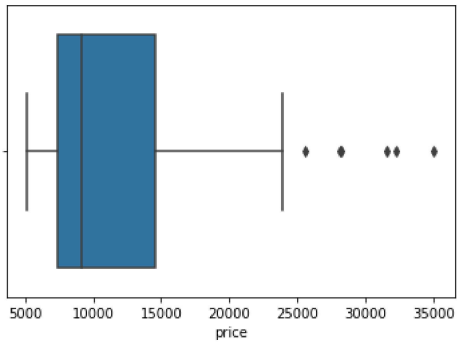
```
symboling           0
normalizedlosses    0
make                0
fuel-type           0
aspiration          0
num-of-doors        0
body-style          0
drive-wheels        0
engine-location     0
wheel-base          0
length              0
width               0
height              0
curb-weight         0
engine-type         0
num-of-cylinders    0
engine-size         0
```

```
fuel-system         0
bore                0
stroke              0
compression-ratio   0
horsepower          0
peakrpm             0
city-mpg            0
highway-mpg         0
price               0
dtype: int64
```

```
import seaborn as sns
sns.boxplot(df["price"])

```

```
E:\Anaconda\lib\site-packages\seaborn\_decorators.py:36: FutureWarning: Pass the followi
  warnings.warn(
<AxesSubplot:xlabel='price'>
```




```
def outliers_iqr(a):
  z=[]
  quartile_1,quartile_3=np.percentile(a,[25,75])
  iqr=quartile_3-quartile_1
  lower_bound=quartile_1-(iqr*1.5)
  upper_bound=quartile_3+(iqr*1.5)
  x=np.where((a>upper_bound)|(a<lower_bound))
  for i in x:
     z.append(x)
  return(z)
```

```
outliers_iqr(df["price"])
```

```
[(array([33, 45, 46, 47, 48, 49], dtype=int64),)]
```

```
df.drop([32, 47],axis=0,inplace=True)
```

```
df.head()
```

	symboling	normalizedlosses	make	fuel-type	aspiration	num-of-doors	body-style	drive-wheels	engine-location
3	2	164.0	audi	gas	std	four	sedan	fwd	front
4	2	164.0	audi	gas	std	four	sedan	4wd	front
6	1	158.0	audi	gas	std	four	sedan	fwd	front
8	1	158.0	audi	gas	turbo	four	sedan	fwd	front
10	2	192.0	bmw	gas	std	two	sedan	rwd	front

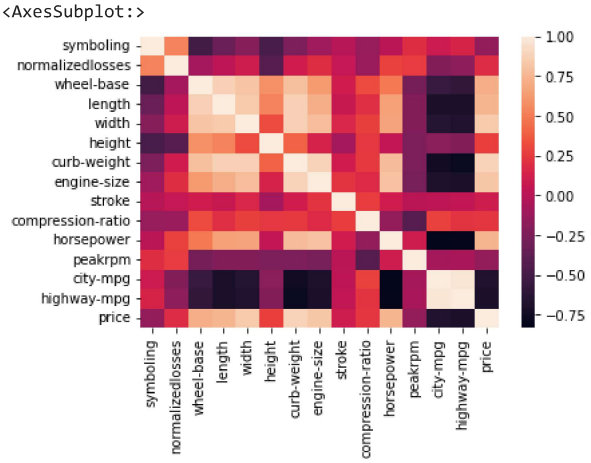
```
df.dtypes

```

```
symboling              int64
normalizedlosses     float64
make                  object
fuel-type             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                  object
stroke               float64
compression-ratio    float64
horsepower             int32
peakrpm                int32
city-mpg               int64
highway-mpg            int64
price                  int32
dtype: object
```

```
1 import seaborn as sns
2 sns.heatmap(df.corr())
```

```
<AxesSubplot:>
```




```
1 df.corr()
```

symboling	normalizedlosses	wheel-base	length	width	height

```
df=df.drop(["wheel-base"],axis=1)
df.head()
df.shape
```

```
(158, 25)
```

```
df=df.drop(["make"],axis=1)
df.head()
df.shape
```

```
(158, 24)
```

```
df=df.drop(["fuel-system","aspiration","num-of-doors","body-style","drive-wheels","engine-location","fuel-s
df.head()
df.shape
```

```
(158, 18)
```

```
df=df.drop(["fuel-type"],axis=1)
df.head()
df.shape
```

```
(158, 17)
```

```
df=df.drop(["engine-type"],axis=1)
df.head()
df.shape
```

```
(158, 16)
```

```
df=df.drop(["num-of-cylinders"],axis=1)
df.head()
df.shape
```

```
(158, 15)
```

```
df.head()
```

	symboling	normalizedlosses	length	width	height	curb-weight	engine-size	bore	stroke	c
3	2	164.0	176.6	66.2	54.3	2337	109	3.19	3.4	
4	2	164.0	176.6	66.4	54.3	2824	136	3.19	3.4	
6	1	158.0	192.7	71.4	55.7	2844	136	3.19	3.4	
8	1	158.0	192.7	71.4	55.9	3086	131	3.13	3.4	

```
from sklearn.decomposition import PCA
pca = PCA(n_components=1)
pca
```

```
PCA(n_components=1)
```

```
principalComponents = pca.fit_transform(df)

```

```
principalComponents.shape
```

```
(158, 1)
```

```
print(principalComponents[:])

```

```
[[ 2595.28031554]
 [ 6121.21712957]
 [ 6381.95115049]
 [12547.68375819]
 [ 5068.73388433]
 [ 5562.37248451]
 [ 9639.9412759 ]
 [ 9778.56675541]
 [-6236.47886471]
 [-5071.32507407]
 [-4789.56777207]
 [-5793.49308563]
 [-4990.70048048]
 [-3396.55508139]
 [-5131.64464088]
 [-4668.31937731]
 [-3753.84152692]
 [-2792.5940468 ]
 [-2398.95706433]
 [ 1653.39275246]
 [-4891.62328263]
 [-4524.72507763]
 [-4841.06637537]
 [-4241.55393477]
 [-4072.05531666]
 [-4071.08532144]
 [-3454.51933067]
 [-2253.96840302]
 [-2502.20400175]
 [-1051.25142549]
 [ 1598.28427912]
 [-1003.08708259]
 [-6161.82398094]
 [-5263.57897355]
 [-4565.1409342 ]
 [-4661.9368335 ]
 [-3963.49879291]
 [-2482.99527051]
 [-2830.23243486]
 [ -737.80853313]
 [-1085.04569748]
 [  -86.70610008]
 [ 6944.3287484 ]
 [14266.51442304]
 [16972.17667301]
 [16881.83860748]
 [20316.42824154]
 [23751.82641139]
 [-5972.87774324]
 [-5173.18199344]
 [-4690.14206989]
 [-3662.53109573]
 [-1382.30422828]
 [-2834.79307445]
 [-4337.98529516]
 [-3138.37906294]
 [-2058.0699862 ]
 [-2058.05554879]
```

```
pca.explained_variance_ratio_
```

```
array([0.99192393])
```

```
plt.plot(range(2), pca.explained_variance_ratio_,label="Variance-ratio")
plt.plot(range(2), np.cumsum(pca.explained_variance_ratio_),label="cumulative variance-ratio")
plt.title("Component-wise and Cumulative Explained Variance")
plt.xlabel("No.of components")
plt.ylabel("Data_explained")
```

```
---------------------------------------------------------------------------
ValueError                                Traceback (most recent call last)
Input In [189], in <cell line: 1>()
----> 1 plt.plot(range(2), pca.explained_variance_ratio_,label="Variance-ratio")
      2 plt.plot(range(2), np.cumsum(pca.explained_variance_ratio_),label="cumulative
variance-ratio")
      3 plt.title("Component-wise and Cumulative Explained Variance")

File E:\Anaconda\lib\site-packages\matplotlib\pyplot.py:2757, in plot(scalex, scaley,
data, *args, **kwargs)
   2755 @_copy_docstring_and_deprecators(Axes.plot)
   2756 def plot(*args, scalex=True, scaley=True, data=None, **kwargs):
-> 2757     return gca().plot(
   2758         *args, scalex=scalex, scaley=scaley,
   2759         **({"data": data} if data is not None else {}), **kwargs)

File E:\Anaconda\lib\site-packages\matplotlib\axes\_axes.py:1632, in Axes.plot(self,
scalex, scaley, data, *args, **kwargs)
   1390 """
   1391 Plot y versus x as lines and/or markers.
   1392
   (...)
   1629 (``'green'``) or hex strings (``'#008000'``).
   1630 """
   1631 kwargs = cbook.normalize_kwargs(kwargs, mlines.Line2D)
-> 1632 lines = [*self._get_lines(*args, data=data, **kwargs)]
   1633 for line in lines:
   1634     self.add_line(line)

File E:\Anaconda\lib\site-packages\matplotlib\axes\_base.py:312, in
_process_plot_var_args.__call__(self, data, *args, **kwargs)
    310     this += args[0],
    311     args = args[1:]
--> 312 yield from self._plot_args(this, kwargs)

File E:\Anaconda\lib\site-packages\matplotlib\axes\_base.py:498, in
_process_plot_var_args._plot_args(self, tup, kwargs, return_kwargs)
    495     self.axes.yaxis.update_units(y)
    497 if x.shape[0] != y.shape[0]:
--> 498     raise ValueError(f"x and y must have same first dimension, but "
    499                      f"have shapes {x.shape} and {y.shape}")
    500 if x.ndim > 2 or y.ndim > 2:
    501     raise ValueError(f"x and y can be no greater than 2D, but have "
    502                      f"shapes {x.shape} and {y.shape}")

ValueError: x and y must have same first dimension, but have shapes (2,) and (1,)
```

SEARCH STACK OVERFLOW


```
#Linear Regression
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
from sklearn.model_selection import train_test_split

```

```
from sklearn.metrics import mean_squared_error, r2_score
```

```
training_features = [ 'length','width','curb-weight','horsepower']
target = 'price'
```

```
X_train, X_test, Y_train, Y_test = train_test_split(df[training_features],
                                                    df[target],
                                                     test_size=0.1,random_state=222)
```

```
from sklearn import linear_model
model = linear_model.LinearRegression()
model.fit(X_train,Y_train)
```

```
model.coef_
```

```
model.intercept_
```

```
predicted=model.predict(X_test)
print("Mean squared error: %.2f"
              % mean_squared_error(Y_test, predicted))
```

```
print('R Square score: %.2f' % r2_score(Y_test, predicted))
```

```
from sklearn.model_selection import cross_val_score
```

```
scores = cross_val_score(model, X_train, Y_train,cv=10)
```

```
scores
```

```
print("Accuracy: %0.2f (+/- %0.2f)" % (scores.mean(), 3* scores.std() ))
```

```
Accuracy: 0.73 (+/- 0.30)
```

```
#Lasso Regression


model =linear_model.Lasso(alpha=5)
model.fit(X_train,Y_train)

from sklearn.metrics import mean_squared_error, r2_score
training_features = [ 'length','width','curb-weight','horsepower']
target = 'price'
X_train, X_test, Y_train, Y_test = train_test_split(df[training_features],
                                                    df[target],
                                                     test_size=0.1,random_state=222)


```

```
predicted=model.predict(X_test)
print("Mean squared error: %.2f"
              % mean_squared_error(Y_test, predicted))
print('R Square score: %.2f' % r2_score(Y_test, predicted))
```

```
Mean squared error: 5874511.49
R Square score: 0.80
```

```
from sklearn.model_selection import cross_val_score

scores = cross_val_score(model, X_train, Y_train,cv=10)

scores

```

```
array([0.85283967, 0.5496465 , 0.09993309, 0.82811057, 0.78175393,
       0.83087709, 0.75097281, 0.68421817, 0.71114213, 0.81003868])
```

```
print("Accuracy: %0.2f (+/- %0.2f)" % (scores.mean(), 3* scores.std() ))
```

```
Accuracy: 0.69 (+/- 0.64)
```

```
#RidgeRegression

```

```

import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
from sklearn.model_selection import train_test_split

from sklearn.metrics import mean_squared_error, r2_score
training_features = [ 'length','width','curb-weight','horsepower']
target = 'price'
X_train, X_test, Y_train, Y_test = train_test_split(df[training_features],
                                                    df[target],
                                                     test_size=0.1,random_state=222)


```

```
model =linear_model.Ridge(alpha=10)
model.fit(X_train,Y_train)
```

```
Ridge(alpha=10)
```

```
predicted=model.predict(X_test)
print("Mean squared error: %.2f"
              % mean_squared_error(Y_test, predicted))

print('R Square score: %.2f' % r2_score(Y_test, predicted))
```

```
Mean squared error: 6109120.80
R Square score: 0.79
```

```

from sklearn.model_selection import cross_val_score

scores = cross_val_score(model, X_train, Y_train,cv=10)

scores

```

```
array([0.85029325, 0.52637566, 0.13488245, 0.82427246, 0.78136647,
       0.83054025, 0.76262181, 0.69171734, 0.71140007, 0.80903254])
```

```
print("Accuracy: %0.2f (+/- %0.2f)" % (scores.mean(), 3* scores.std() ))
```

```
Accuracy: 0.69 (+/- 0.62)
```

```
#KNN Regressor


from sklearn.neighbors import KNeighborsRegressor
model = KNeighborsRegressor(n_neighbors=4,
                            p=2,weights='distance')
model.fit(X_train,Y_train)
```

```
KNeighborsRegressor(n_neighbors=4, weights='distance')
```

```
predicted=model.predict(X_test)
print("Mean squared error: %.2f"
              % mean_squared_error(Y_test, predicted))

print('R Square score: %.2f' % r2_score(Y_test, predicted))
```

```
Mean squared error: 12388238.85
R Square score: 0.58
```

```

from sklearn.model_selection import cross_val_score

scores = cross_val_score(model, X_train, Y_train,cv=10)

scores

```

```
array([0.85893749, 0.63650288, 0.45239699, 0.87645662, 0.88335373,
       0.77703851, 0.84099436, 0.55447214, 0.70865977, 0.94697372])
```

```
print("Accuracy: %0.2f (+/- %0.2f)" % (scores.mean(), 3* scores.std() ))
```

```
Accuracy: 0.75 (+/- 0.46)
```

```
#Neural Network

from sklearn.neural_network import MLPRegressor
```

```
from sklearn.metrics import mean_squared_error, r2_score
training_features = [ 'length','width','curb-weight','horsepower']
target = 'price'
X_train, X_test, Y_train, Y_test = train_test_split(df[training_features],
                                                     df[target],
                                                      test_size=0.1,random_state=222)

```

```
model =MLPRegressor(hidden_layer_sizes=(100,10,50),activation='tanh')
```

```
model.fit(X_train,Y_train)
```

```
E:\Anaconda\lib\site-packages\sklearn\neural_network\_multilayer_perceptron.py:692: ConvergenceWarning: Stochastic Optimizer: Maximum it
  warnings.warn(
MLPRegressor(activation='tanh', hidden_layer_sizes=(100, 10, 50))
```

```
predicted=model.predict(X_test)
print("Mean squared error: %.2f"
              % mean_squared_error(Y_test, predicted))

print('R Square score: %.2f' % r2_score(Y_test, predicted))
```

```
Mean squared error: 222069320.54
R Square score: -6.54
```

```
from sklearn.model_selection import cross_val_score

scores = cross_val_score(model, X_train, Y_train,cv=10)

scores

```

```
E:\Anaconda\lib\site-packages\sklearn\neural_network\_multilayer_perceptron.py:692: ConvergenceWarning: Stochastic Optimizer: Maximum it
  warnings.warn(
E:\Anaconda\lib\site-packages\sklearn\neural_network\_multilayer_perceptron.py:692: ConvergenceWarning: Stochastic Optimizer: Maximum it
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  warnings.warn(
E:\Anaconda\lib\site-packages\sklearn\neural_network\_multilayer_perceptron.py:692: ConvergenceWarning: Stochastic Optimizer: Maximum it
  warnings.warn(
```

```
E:\Anaconda\lib\site-packages\sklearn\neural_network\_multilayer_perceptron.py:692: ConvergenceWarning: Stochastic Optimizer: Maximum it
  warnings.warn(
E:\Anaconda\lib\site-packages\sklearn\neural_network\_multilayer_perceptron.py:692: ConvergenceWarning: Stochastic Optimizer: Maximum it
  warnings.warn(
array([ -4.72904487,  -6.76958747, -13.35388065,  -2.4503772 ,
        -3.35492748,  -5.91468527,  -4.16524559,  -5.31747154,
        -6.16531129,  -3.29268685])
```

```
1
2 print("Accuracy: %0.2f (+/- %0.2f)" % (scores.mean(), 3* scores.std() ))
3
```

```
Accuracy: -5.55 (+/- 8.75)
```

```
1
```

```
1 #Regression trees
2
3 from sklearn.model_selection import train_test_split,GridSearchCV
4
5 from sklearn import datasets, linear_model
6 from sklearn.metrics import mean_squared_error, r2_score
7 from sklearn.model_selection import train_test_split
8 from sklearn.tree import DecisionTreeRegressor
9 model = DecisionTreeRegressor(criterion='mae',max_depth=5,min_samples_leaf=4,min_samples_split=4)
10 model.fit(X_train,Y_train)
```

```
E:\Anaconda\lib\site-packages\sklearn\tree\_classes.py:366: FutureWarning: Criterion 'mae' was deprecated in v1.0 and will be removed ir
  warnings.warn(
DecisionTreeRegressor(criterion='mae', max_depth=5, min_samples_leaf=4,
                      min_samples_split=4)
```

```
1 predicted=model.predict(X_test)
2 print("Mean squared error: %.2f"
3               % mean_squared_error(Y_test, predicted))
4
5 print('R Square score: %.2f' % r2_score(Y_test, predicted))
```

```
Mean squared error: 9519435.94
R Square score: 0.68
```

```
1 from sklearn.tree import plot_tree
2 plot_tree(model,filled=True)
```

```
[Text(0.6176470588235294, 0.9166666666666666, 'X[2] <= 2664.0\nmae =
3818.239\nsamples = 142\nvalue = 8948.5'),
 Text(0.36764705882352944, 0.75, 'X[2] <= 2291.5\nmae = 1502.549\nsamples =
102\nvalue = 7896.5'),
 Text(0.19117647058823528, 0.5833333333333334, 'X[2] <= 1998.5\nmae =
835.453\nsamples = 64\nvalue = 7163.5'),
 Text(0.11764705882352941, 0.4166666666666667, 'X[2] <= 1902.5\nmae =
558.679\nsamples = 28\nvalue = 6504.0'),
 Text(0.058823529411764705, 0.25, 'X[2] <= 1875.0\nmae = 509.889\nsamples = 9\nvalue
= 6095.0'),
 Text(0.029411764705882353, 0.08333333333333333, 'mae = 472.0\nsamples = 4\nvalue =
6387.0'),
 Text(0.08823529411764706, 0.08333333333333333, 'mae = 355.6\nsamples = 5\nvalue =
5572.0'),
 Text(0.17647058823529413, 0.25, 'X[0] <= 158.75\nmae = 487.0\nsamples = 19\nvalue =
6692.0'),
 Text(0.14705882352941177, 0.08333333333333333, 'mae = 546.1\nsamples = 10\nvalue =
6229.0'),
 Text(0.20588235294117646, 0.08333333333333333, 'mae = 270.111\nsamples = 9\nvalue =
6795.0'),
 Text(0.2647058823529412, 0.4166666666666667, 'X[1] <= 63.7\nmae = 631.056\nsamples =
36\nvalue = 7775.0'),
 Text(0.23529411764705882, 0.25, 'mae = 503.0\nsamples = 5\nvalue = 6488.0'),
 Text(0.29411764705882354, 0.25, 'X[3] <= 83.5\nmae = 506.71\nsamples = 31\nvalue =
7799.0'),
 Text(0.2647058823529412, 0.08333333333333333, 'mae = 388.667\nsamples = 21\nvalue =
7738.0'),
 Text(0.3235294117647059, 0.08333333333333333, 'mae = 571.5\nsamples = 10\nvalue =
8345.0'),
 Text(0.5441176470588235, 0.5833333333333334, 'X[2] <= 2422.5\nmae =
```

```python
from sklearn.model_selection import cross_val_score

scores = cross_val_score(model, X_train, Y_train,cv=10)

scores
```

```
E:\Anaconda\lib\site-packages\sklearn\tree\_classes.py:366: FutureWarning: Criterion 'mae' was deprecated in v1.0 and will be removed ir
  warnings.warn(
E:\Anaconda\lib\site-packages\sklearn\tree\_classes.py:366: FutureWarning: Criterion 'mae' was deprecated in v1.0 and will be removed ir
  warnings.warn(
E:\Anaconda\lib\site-packages\sklearn\tree\_classes.py:366: FutureWarning: Criterion 'mae' was deprecated in v1.0 and will be removed ir
  warnings.warn(
E:\Anaconda\lib\site-packages\sklearn\tree\_classes.py:366: FutureWarning: Criterion 'mae' was deprecated in v1.0 and will be removed ir
  warnings.warn(
E:\Anaconda\lib\site-packages\sklearn\tree\_classes.py:366: FutureWarning: Criterion 'mae' was deprecated in v1.0 and will be removed ir
  warnings.warn(
E:\Anaconda\lib\site-packages\sklearn\tree\_classes.py:366: FutureWarning: Criterion 'mae' was deprecated in v1.0 and will be removed ir
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E:\Anaconda\lib\site-packages\sklearn\tree\_classes.py:366: FutureWarning: Criterion 'mae' was deprecated in v1.0 and will be removed ir
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E:\Anaconda\lib\site-packages\sklearn\tree\_classes.py:366: FutureWarning: Criterion 'mae' was deprecated in v1.0 and will be removed ir
  warnings.warn(
E:\Anaconda\lib\site-packages\sklearn\tree\_classes.py:366: FutureWarning: Criterion 'mae' was deprecated in v1.0 and will be removed ir
  warnings.warn(
E:\Anaconda\lib\site-packages\sklearn\tree\_classes.py:366: FutureWarning: Criterion 'mae' was deprecated in v1.0 and will be removed ir
  warnings.warn(
array([0.81474477, 0.62690434, 0.44097421, 0.82795639, 0.89808225,
       0.74624446, 0.88347892, 0.71621996, 0.77092197, 0.94997441])
```

```python
print("Accuracy: %0.2f (+/- %0.2f)" % (scores.mean(), 3* scores.std() ))
```

```
Accuracy: 0.77 (+/- 0.42)
```

```python
#SVR

from sklearn.svm import SVR
model = SVR(kernel='linear')
model.fit(X_train,Y_train)
```

```
SVR(kernel='linear')
```

```python
predicted=model.predict(X_test)
print("Mean squared error: %.2f"
              % mean_squared_error(Y_test, predicted))
```

```
4
5 print('R Square score: %.2f' % r2_score(Y_test, predicted))
```

```
Mean squared error: 9794854.40
R Square score: 0.67
```

```
1
2 from sklearn.model_selection import cross_val_score
3
4 scores = cross_val_score(model, X_train, Y_train,cv=10)
5
6 scores
```

```
array([0.81111938, 0.6505549 , 0.48148009, 0.73129806, 0.73213532,
       0.80326901, 0.81236196, 0.68020696, 0.81925003, 0.76819261])
```

```
1 print("Accuracy: %0.2f (+/- %0.2f)" % (scores.mean(), 3* scores.std() ))
```

```
Accuracy: 0.73 (+/- 0.30)
```

```
1
```

```
1
```

```
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```

```
1
```

```
1
```

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