Importing Libraries

In [159]:

```
import pandas as pd
import numpy as np
from sklearn.preprocessing import StandardScaler
from sklearn.preprocessing import LabelEncoder
from sklearn.preprocessing import OneHotEncoder
from sklearn.linear_model import LinearRegression
from sklearn.metrics import mean_squared_error, r2_score
from sklearn.ensemble import RandomForestRegressor
from sklearn.model_selection import train_test_split
from sklearn.tree import DecisionTreeRegressor
from matplotlib import pyplot

import matplotlib.pyplot as plt
import seaborn as sns
```

Reading Data

In [160]:

```
X_train = pd.read_csv('X_train.csv')
X_test = pd.read_csv('X_test.csv')
y_train = pd.read_csv('y_train.csv')
label = pd.read_csv('y_test.csv')
```

Analysis of data on various factors

In [161]:

```
print(X_train.head())
print(y_train.head())
print(X_train.info())
print(X_train.describe())
print(X_train.isnull().sum())
print(X_test.info())
print(X_test.describe())
print(X_test.isnull().sum())
```

```
   carID     brand      model  year transmission  mileage fuelType
tax  \
0  13207    hyundi   Santa Fe  2019    Semi-Auto     4223   Diesel
145.0
1  17314  vauxhall        GTC  2015       Manual    47870   Diesel
125.0
2  12342      audi        RS4  2019    Automatic     5151   Petrol
145.0
3  13426        vw   Scirocco  2016    Automatic    20423   Diesel
30.0
4  16004     skoda      Scala  2020    Semi-Auto     3569   Petrol
145.0

    mpg  engineSize
0  39.8         2.2
1  60.1         2.0
2  29.1         2.9
3  57.6         2.0
4  47.1         1.0
   carID  price
```

Droping the attributes

In [162]:

```
drop = ['carID', 'brand']
trainx = X_train.drop(columns=drop,axis=1)
testx = X_test.drop(columns=drop,axis=1)
```

In [163]:

```
obj = trainx.select_dtypes(include = object).columns
num = trainx.select_dtypes(exclude = object).columns
```

Encoding the categorical Data using Label Encoding

In [164]:

```
df = pd.concat([trainx.assign(ind='train'),testx.assign(ind='test')])
from sklearn.preprocessing import LabelEncoder
encoder = LabelEncoder()
df[obj] = df[obj].apply(encoder.fit_transform)
traind = df[df['ind']=='train'].drop(columns='ind')
testd = df[df['ind']=='test'].drop(columns='ind')
```

In [165]:

```
traind
```

Out[165]:

	model	year	transmission	mileage	fuelType	tax	mpg	engineSize
0	69	2019	3	4223	0	145.0	39.8	2.2
1	30	2015	1	47870	0	125.0	60.1	2.0
2	58	2019	0	5151	4	145.0	29.1	2.9
3	71	2016	0	20423	0	30.0	57.6	2.0
4	70	2020	3	3569	4	145.0	47.1	1.0
...	...	...	...	...	...	...	...	...
4955	26	2015	0	24314	0	125.0	56.6	2.1
4956	0	2017	0	18000	0	145.0	51.4	3.0
4957	11	2015	1	84932	0	30.0	60.1	2.0
4958	3	2017	3	30150	0	145.0	62.8	3.0
4959	66	2014	0	40230	0	150.0	56.5	3.0

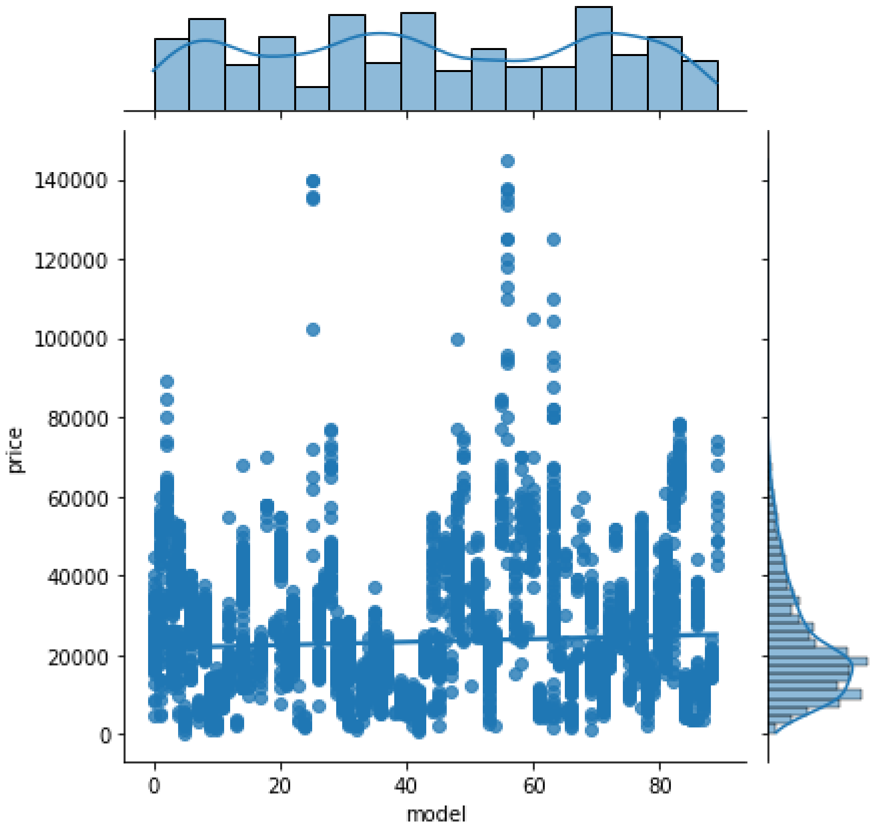
4960 rows × 8 columns

Analysis of the different Attributes with Dependent Attribute

In [166]:

```
sns.jointplot(traind.model, y_train.price, kind = "reg")
plt.show()
```

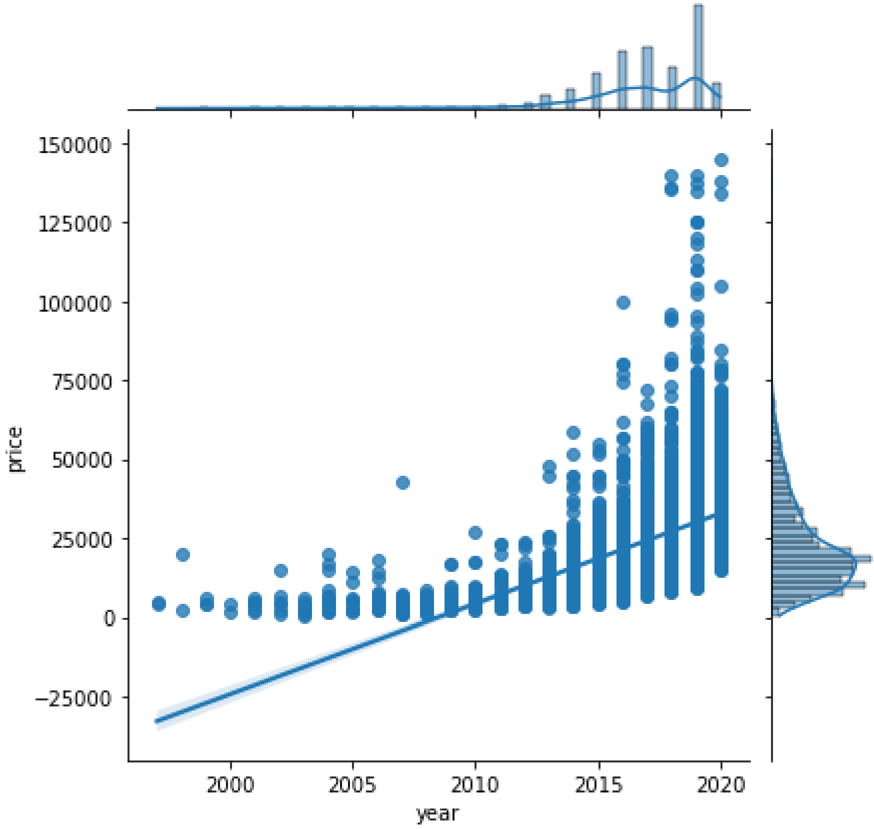
```
/home/shield/anaconda3/lib/python3.9/site-packages/seaborn/_decorator
s.py:36: FutureWarning: Pass the following variables as keyword args:
x, y. From version 0.12, the only valid positional argument will be `d
ata`, and passing other arguments without an explicit keyword will res
ult in an error or misinterpretation.
  warnings.warn(
```



```
In [167]:
```

```
sns.jointplot(traind.year, y_train.price, kind = "reg")
plt.show()
```

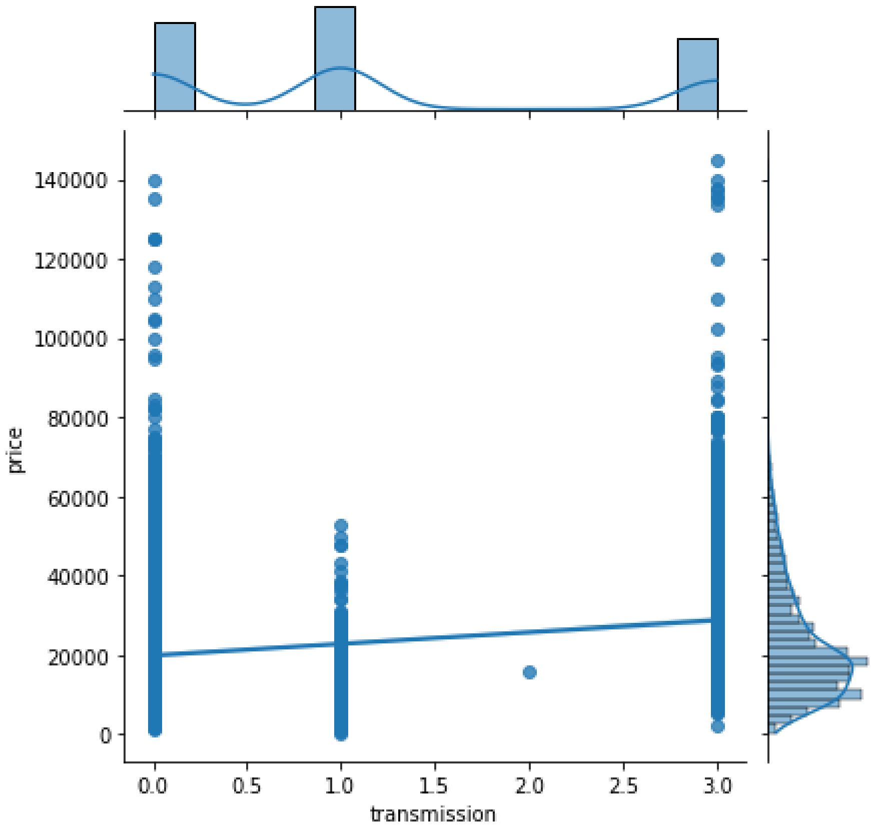
```
/home/shield/anaconda3/lib/python3.9/site-packages/seaborn/_decorator
s.py:36: FutureWarning: Pass the following variables as keyword args:
x, y. From version 0.12, the only valid positional argument will be `d
ata`, and passing other arguments without an explicit keyword will res
ult in an error or misinterpretation.
  warnings.warn(
```



In [168]:

```
sns.jointplot(traind.transmission, y_train.price, kind = "reg")
plt.show()
```

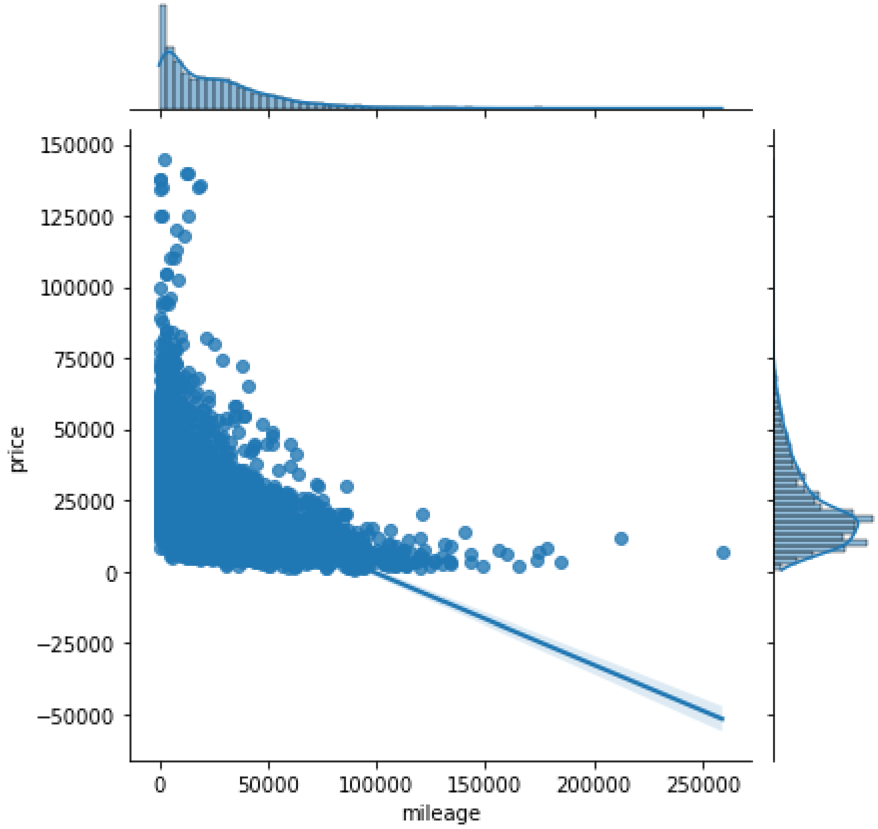
```
/home/shield/anaconda3/lib/python3.9/site-packages/seaborn/_decorator
s.py:36: FutureWarning: Pass the following variables as keyword args:
x, y. From version 0.12, the only valid positional argument will be `d
ata`, and passing other arguments without an explicit keyword will res
ult in an error or misinterpretation.
  warnings.warn(
```



In [169]:

```
sns.jointplot(traind.mileage, y_train.price, kind = "reg")
plt.show()
```

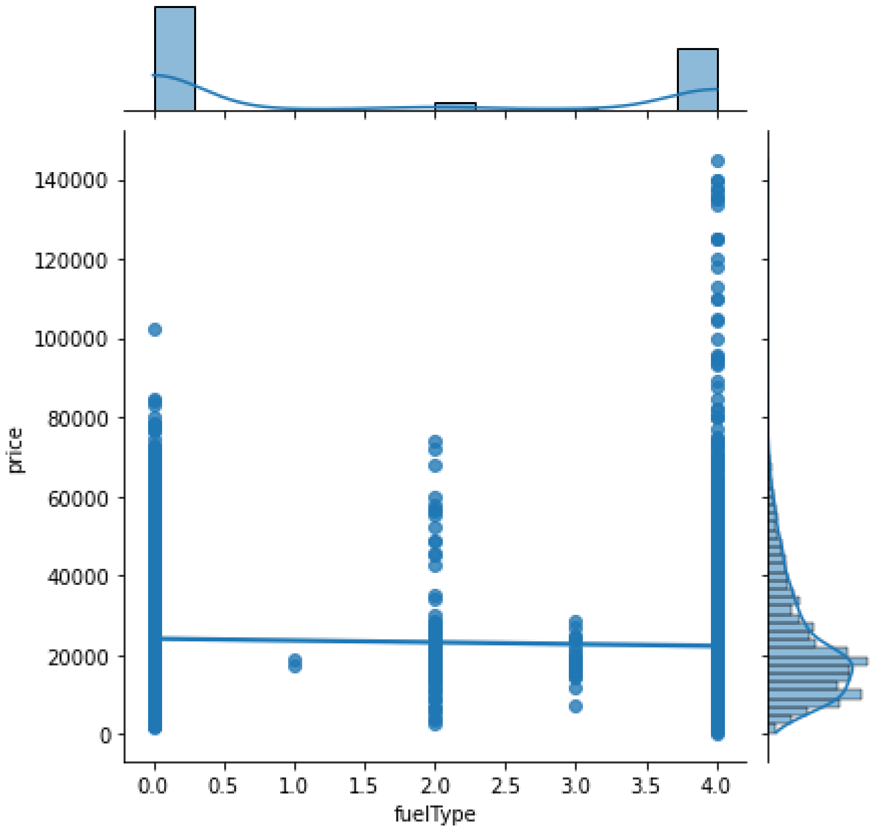
```
/home/shield/anaconda3/lib/python3.9/site-packages/seaborn/_decorator
s.py:36: FutureWarning: Pass the following variables as keyword args:
x, y. From version 0.12, the only valid positional argument will be `d
ata`, and passing other arguments without an explicit keyword will res
ult in an error or misinterpretation.
  warnings.warn(
```



In [170]:

```
sns.jointplot(traind.fuelType, y_train.price, kind = "reg")
plt.show()
```

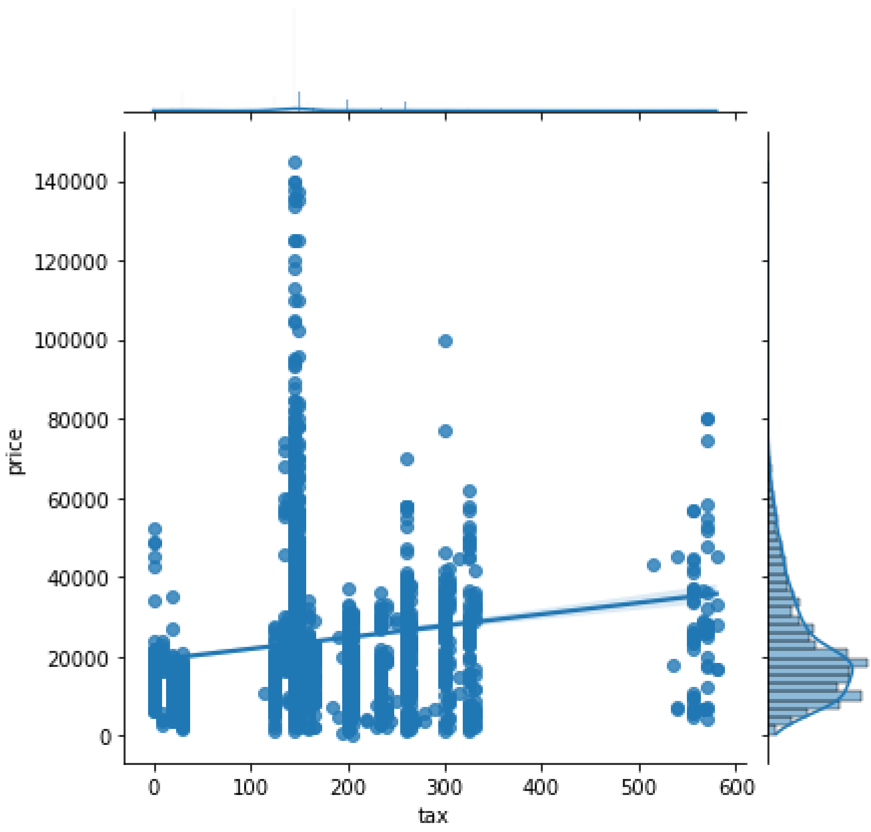
```
/home/shield/anaconda3/lib/python3.9/site-packages/seaborn/_decorator
s.py:36: FutureWarning: Pass the following variables as keyword args:
x, y. From version 0.12, the only valid positional argument will be `d
ata`, and passing other arguments without an explicit keyword will res
ult in an error or misinterpretation.
  warnings.warn(
```



In [171]:

```
sns.jointplot(traind.tax, y_train.price, kind = "reg")
plt.show()
```

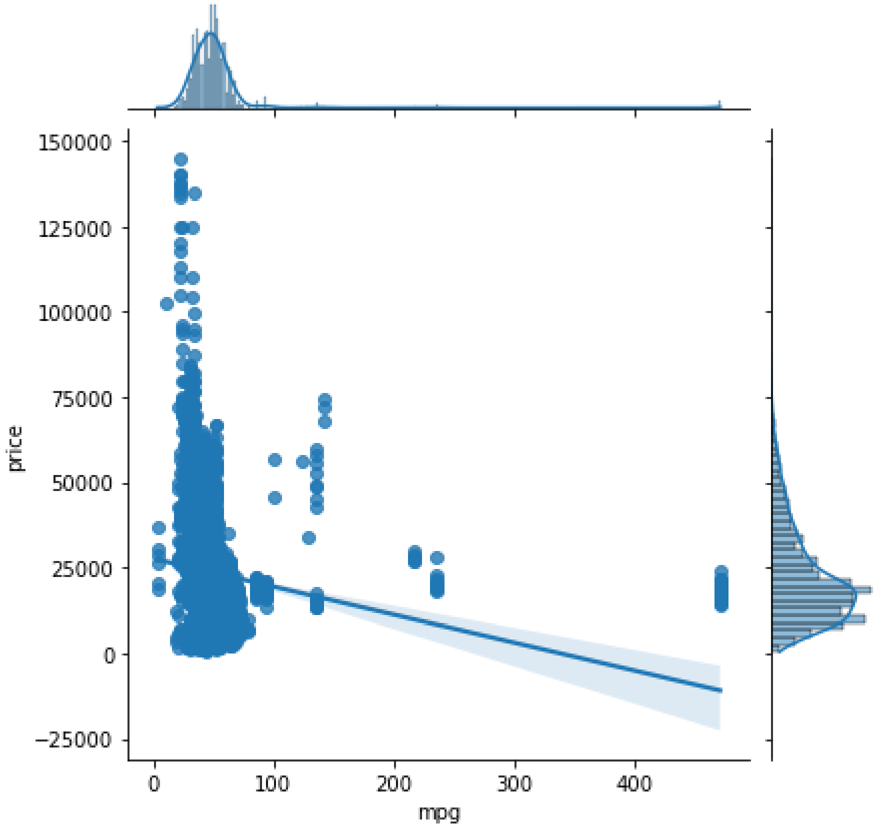
```
/home/shield/anaconda3/lib/python3.9/site-packages/seaborn/_decorator
s.py:36: FutureWarning: Pass the following variables as keyword args:
x, y. From version 0.12, the only valid positional argument will be `d
ata`, and passing other arguments without an explicit keyword will res
ult in an error or misinterpretation.
  warnings.warn(
```



In [172]:

```
sns.jointplot(traind.mpg, y_train.price, kind = "reg")
plt.show()
```

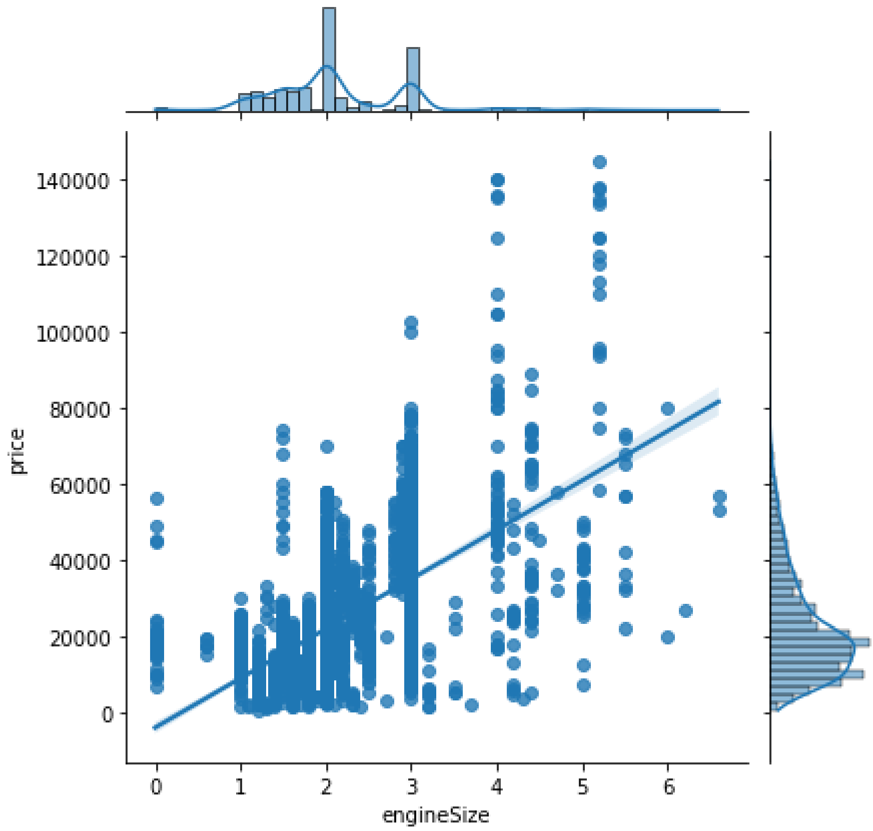
```
/home/shield/anaconda3/lib/python3.9/site-packages/seaborn/_decorator
s.py:36: FutureWarning: Pass the following variables as keyword args:
x, y. From version 0.12, the only valid positional argument will be `d
ata`, and passing other arguments without an explicit keyword will res
ult in an error or misinterpretation.
  warnings.warn(
```



In [173]:

```
sns.jointplot(traind.engineSize, y_train.price, kind = "reg")
plt.show()
```

```
/home/shield/anaconda3/lib/python3.9/site-packages/seaborn/_decorator
s.py:36: FutureWarning: Pass the following variables as keyword args:
x, y. From version 0.12, the only valid positional argument will be `d
ata`, and passing other arguments without an explicit keyword will res
ult in an error or misinterpretation.
  warnings.warn(
```



Scaling the data using feautre scaling standardisation

In [174]:

```
from sklearn.preprocessing import StandardScaler
scaler = StandardScaler()
trains = scaler.fit_transform(traind)
tests = scaler.transform(testd)
```

In [175]:

```
trains
```

Out[175]:

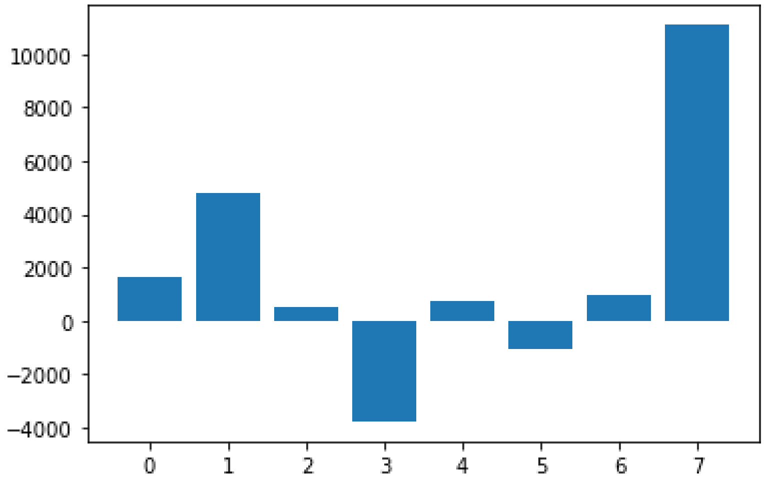
```
array([[ 0.96270737,  0.78443036,  1.52341148, ..., -0.08899343,
        -0.29574449,  0.09581413],
       [-0.5264344 , -0.60265505, -0.1789927 , ..., -0.33172502,
         0.27220045, -0.15757862],
       [ 0.54269302,  0.78443036, -1.03019479, ..., -0.08899343,
        -0.59510464,  0.98268877],
       ...,
       [-1.25191373, -0.60265505, -0.1789927 , ..., -1.4847001 ,
         0.27220045, -0.15757862],
       [-1.5573787 ,  0.09088765,  1.52341148, ..., -0.08899343,
         0.34773993,  1.10938515],
       [ 0.848158  , -0.9494264 , -1.03019479, ..., -0.02831053,
         0.17148115,  1.10938515]])
```

Calculating the Feature Importance

In [176]:

```
xt,xv,yt,yv = train_test_split(trains, y_train['price'], test_size=0.2,random_state
model = LinearRegression()
model.fit(xt,yt)
importance = model.coef_
for i,v in enumerate(importance):
    print('Feature: %0d, Score: %.5f' % (i,v))
pyplot.bar([x for x in range(len(importance))], importance)
pyplot.show()
```

```
Feature: 0, Score: 1607.72234
Feature: 1, Score: 4795.33066
Feature: 2, Score: 489.40376
Feature: 3, Score: -3769.33351
Feature: 4, Score: 757.47698
Feature: 5, Score: -1063.27324
Feature: 6, Score: 966.04659
Feature: 7, Score: 11098.66900
```



Application of the Linear Regression

In [177]:

```
model = LinearRegression()
model.fit(xt,yt)
pred = model.predict(xv)
print(r2_score(yv,pred))
```

```
0.6702766155287029
```

Application of the Decision Tree Regression

In [178]:

```
max_r2 = 0.00
dep = 1

for i in range(0,25):
    regr_1 = DecisionTreeRegressor(max_depth=i+1)
    regr_1.fit(xt,yt)

    y_1 = regr_1.predict(xv)

    print("Coefficient of determination in Max Depth = %d: %.16f" % (i+2,r2_score(y

    if max_r2< r2_score(yv , y_1):
        max_r2 = r2_score(yv , y_1)
```

```
Coefficient of determination in Max Depth = 2: 0.3551606350804297
Coefficient of determination in Max Depth = 3: 0.5806997241031087
Coefficient of determination in Max Depth = 4: 0.6582925149940793
Coefficient of determination in Max Depth = 5: 0.7435752890529120
Coefficient of determination in Max Depth = 6: 0.7318981509627938
Coefficient of determination in Max Depth = 7: 0.7677805673051984
Coefficient of determination in Max Depth = 8: 0.7670230200100316
Coefficient of determination in Max Depth = 9: 0.7701705234995175
Coefficient of determination in Max Depth = 10: 0.8145829747193420
Coefficient of determination in Max Depth = 11: 0.8278495029515507
Coefficient of determination in Max Depth = 12: 0.7902939931573415
Coefficient of determination in Max Depth = 13: 0.8797317407018166
Coefficient of determination in Max Depth = 14: 0.8693483844891617
Coefficient of determination in Max Depth = 15: 0.7983602931553555
Coefficient of determination in Max Depth = 16: 0.8715297417765482
Coefficient of determination in Max Depth = 17: 0.8590186635729072
Coefficient of determination in Max Depth = 18: 0.8256232852794991
Coefficient of determination in Max Depth = 19: 0.8401262376793444
Coefficient of determination in Max Depth = 20: 0.8304192609957722
Coefficient of determination in Max Depth = 21: 0.8657462812534702
Coefficient of determination in Max Depth = 22: 0.8724486499831271
Coefficient of determination in Max Depth = 23: 0.8189830537372788
Coefficient of determination in Max Depth = 24: 0.8590393972771218
Coefficient of determination in Max Depth = 25: 0.8295958812527475
Coefficient of determination in Max Depth = 26: 0.8335761493796917
```

In [180]:

```
print("Maximum Coefficient of determination : %.16f" % (max_r2))
```

```
Maximum Coefficient of determination : 0.8797317407018166
```

Application of the Random Forest Regression

In [181]:

```
xt,xv,yt,yv = train_test_split(trains, y_train['price'], test_size=0.2,random_state
model = RandomForestRegressor(max_depth=20, random_state=42)
model.fit(xt,yt)
pred = model.predict(xv)
print(r2_score(yv,pred))
```

```
0.9384875416895285
```