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

Build model using LinearRegression

In [2]:
```python
cars = pd.read_csv("final_cars.csv")
```

In [3]:
```python
cars.columns
```

Out[3]:
```
Index(['make', 'fuel-type', 'num-of-doors', 'body-style', 'drive-wheels',
       'curb-weight', 'engine-size', 'highway-mpg', 'price'],
      dtype='object')
```

In [5]:
```python
y = cars['price']
X = cars.drop(columns=['price'])
```

In [6]:
```python
X.sample(5)
```

Out[6]:

	make	fuel-type	num-of-doors	body-style	drive-wheels	curb-weight	engine-size	highway-mpg
122	porsche	gas	two	hatchback	rwd	2778	151	27
131	saab	gas	four	sedan	fwd	2758	121	28
45	jaguar	gas	four	sedan	rwd	4066	258	19
60	mazda	diesel	four	sedan	fwd	2443	122	42
129	saab	gas	four	sedan	fwd	2695	121	28

In [7]:
```python
X  = pd.get_dummies(X)
```

In [8]:
```python
X.shape,y.shape
```

Out[8]:
```
((201, 37), (201,))
```

In [9]:
```python
X.columns
```

Out[9]:
```
Index(['curb-weight', 'engine-size', 'highway-mpg', 'make_alfa-romero',
       'make_audi', 'make_bmw', 'make_chevrolet', 'make_dodge', 'make_honda',
       'make_isuzu', 'make_jaguar', 'make_mazda', 'make_mercedes-benz',
       'make_mercury', 'make_mitsubishi', 'make_nissan', 'make_peugot',
       'make_plymouth', 'make_porsche', 'make_renault', 'make_saab',
       'make_subaru', 'make_toyota', 'make_volkswagen', 'make_volvo',
       'fuel-type_diesel', 'fuel-type_gas', 'num-of-doors_four',
       'num-of-doors_two', 'body-style_convertible', 'body-style_hardtop',
       'body-style_hatchback', 'body-style_sedan', 'body-style_wagon',
       'drive-wheels_4wd', 'drive-wheels_fwd', 'drive-wheels_rwd'],
      dtype='object')
```

In [10]:
```python
from sklearn.model_selection import train_test_split
```

In [11]:
```python
from sklearn.linear_model import LinearRegression
```

In [12]:
```python
X_train, X_test, y_train, y_test = train_test_split(X,y, test_size=0.2, random_state=99)
```

In [13]:
```python
model = LinearRegression()
model.fit(X_train,y_train)
```

Out[13]:
```
LinearRegression()
```

In [14]:
```python
for t in zip(X_train.columns, model.coef_):
  print(f"{t[0]:25s} {t[1]:.0f}")
```

```
curb-weight               6
engine-size               36
highway-mpg               -61
make_alfa-romero          -2153
make_audi                 2658
make_bmw                  7931
make_chevrolet            -121
make_dodge                -2116
make_honda                -1250
make_isuzu                -6058
make_jaguar               6193
make_mazda                -1128
make_mercedes-benz        6816
make_mercury              -1083
make_mitsubishi           -2902
make_nissan               -1874
make_peugot               -3491
make_plymouth             -2727
make_porsche              11762
make_renault              -3278
make_saab                 -340
make_subaru               -2340
make_toyota               -2902
make_volkswagen           -1492
make_volvo                -105
fuel-type_diesel          -15
fuel-type_gas             15
num-of-doors_four         33
num-of-doors_two          -33
body-style_convertible    2856
body-style_hardtop        -1070
body-style_hatchback      -133
body-style_sedan          -67
body-style_wagon          -1586
drive-wheels_4wd          -537
drive-wheels_fwd          -180
drive-wheels_rwd          717
```

In [15]:
```python
model.intercept_
```

Out[15]:
```
-4462.332309511436
```

Calculate accuracy with train data

In [17]:
```python
from sklearn.metrics import mean_squared_error, r2_score, mean_absolute_error
```

In [18]:
```python
y_pred = model.predict(X_train)
print("MSE  : ", mean_squared_error(y_train,y_pred))
print("RMSE : ", np.sqrt(mean_squared_error(y_train,y_pred)))
```

```
MSE  :  3914467.983918011
RMSE :  1978.5014490563335
```

In [19]:
```python
r2score = r2_score(y_train,y_pred)
print(f"R2 Score: {r2score:0.2f}")
```

```
R2 Score: 0.93
```

Test with test data

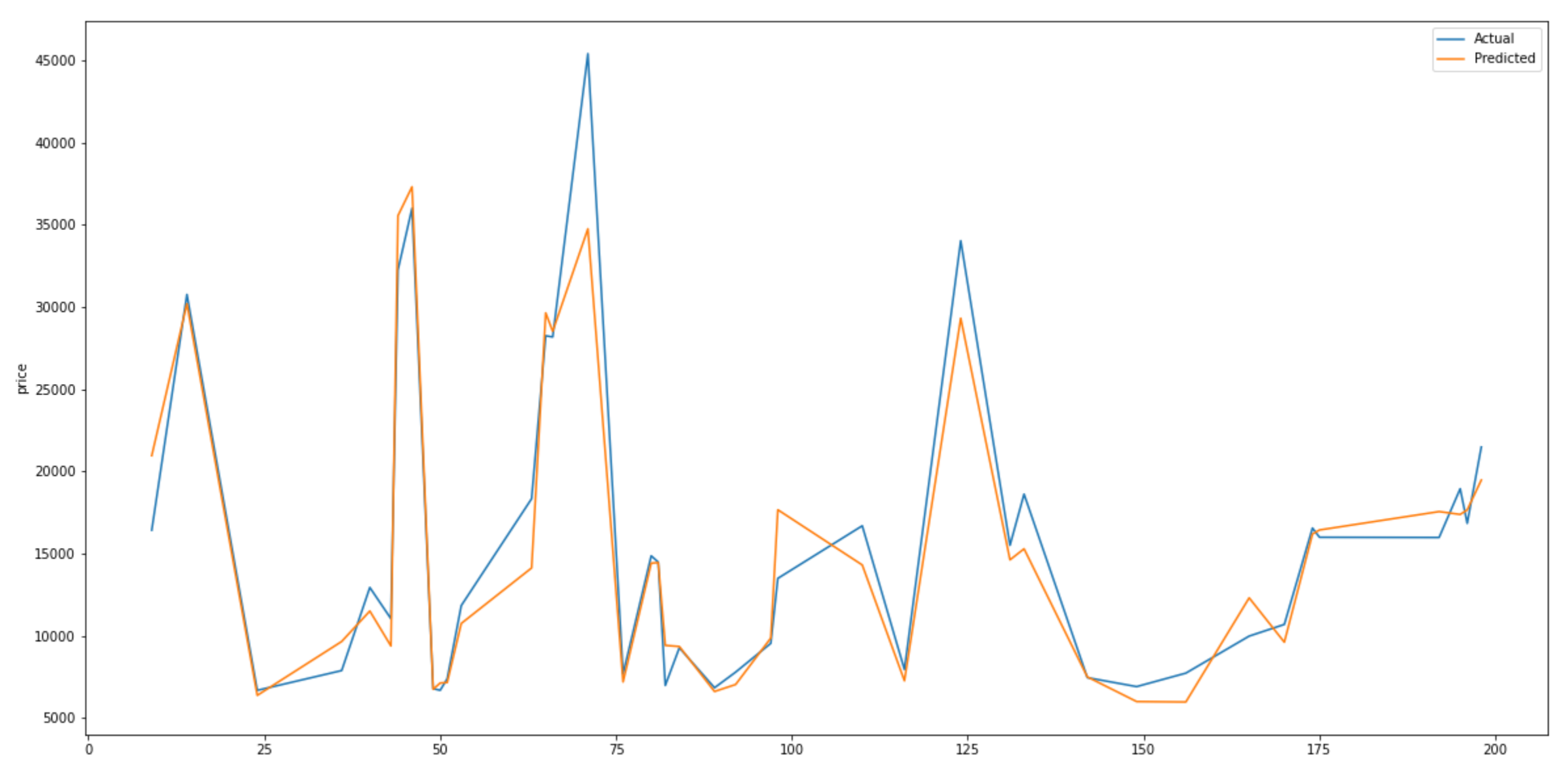
In [20]:
```python
y_pred = model.predict(X_test)
```

In [21]:
```python
mse = mean_squared_error(y_test,y_pred)
print(f"Mean Squared Error : {mse:0.2f}")

rmse = np.sqrt(mse)
print(f"Root Mean Squared Error : {rmse:0.2f}")

r2score = r2_score(y_test,y_pred)
print(f"R2 Score: {r2score:0.2f}")
```

```
Mean Squared Error : 6367777.45
Root Mean Squared Error : 2523.45
R2 Score: 0.93
```

In [22]:
```python
# Compare actual and predicted values
plt.gcf().set_size_inches(20,10)
sns.lineplot( y = y_test, x = X_test.index, label="Actual")
sns.lineplot( y = y_pred, x = X_test.index, label="Predicted")
```

Out[22]:
```
<AxesSubplot:ylabel='price'>
```



In [23]:
```python
for p,a in zip(y_pred[:10],y_test[:10]):
    print(f"{p:6.0f}  -  {a:6.0f} - {p - a:6.0f}")
```

```
 34753  -   45400 - -10647
  6386  -    6692 -   -306
  7168  -    7395 -   -227
 16194  -   16558 -   -364
  9871  -    9549 -    322
 11514  -   12945 -  -1431
 29318  -   34028 -  -4710
  9356  -    9279 -     77
  7508  -    7463 -     45
 14624  -   15510 -   -886
```

In [24]:
```python
# Display % of difference
for p,a in zip(y_pred[:10],y_test[:10]):
    d = p - a
    print(f"{p:6.0f}  -  {a:6.0f} - {p - a:6.0f} - {abs(d / a * 100):5.2f}")
```

```
 34753  -   45400 - -10647 - 23.45
  6386  -    6692 -   -306 -  4.57
  7168  -    7395 -   -227 -  3.07
 16194  -   16558 -   -364 -  2.20
  9871  -    9549 -    322 -  3.37
 11514  -   12945 -  -1431 - 11.06
 29318  -   34028 -  -4710 - 13.84
  9356  -    9279 -     77 -  0.83
  7508  -    7463 -     45 -  0.60
 14624  -   15510 -   -886 -  5.71
```

Model with Standardization

In [25]:
```python
cars = pd.read_csv("final_cars.csv")
```

In [26]:
```python
## create X and Y
y = cars['price']
X = cars.drop(columns=['price'])
```

In [27]:
```python
X = pd.get_dummies(X)
```

In [28]:
```python
X_train, X_test, y_train, y_test = train_test_split(X,y, test_size=0.2, random_state=99)
```

In [29]:
```python
from sklearn.preprocessing import StandardScaler
scaler = StandardScaler()
```

In [30]:
```python
## Scale X_train and X_test
X_train = scaler.fit_transform(X_train)
X_test = scaler.transform(X_test)
```

In [31]:
```python
X_train = pd.DataFrame(X_train,columns = X.columns)
```

In [32]:
```python
X_test = pd.DataFrame(X_test,columns = X.columns)
```

In [33]:
```python
X_test.head()
```

Out[33]:

	curb-weight	engine-size	highway-mpg	make_alfa-romero	make_audi	make_bmw	make_chevrolet	make_dodge	make_honda	make_isuzu	...	num-of-doors_four	num-of-doors_two	body-style_convertible	body-style_hardtop	body-style_hatchback	body-style_sedan	b style_w
0	2.413275	4.982797	-2.238975	-0.138233	-0.197386	-0.197386	-0.138233	-0.229416	-0.271708	-0.079305	...	-1.148408	1.148408	-0.197386	5.567764	-0.733799	-0.916013	-0.37
1	-1.071322	-0.923353	1.017716	-0.138233	-0.197386	-0.197386	-0.138233	4.358899	-0.271708	-0.079305	...	0.870771	-0.870771	-0.197386	-0.179605	-0.733799	1.091687	-0.37
2	-1.150058	-0.895755	1.017716	-0.138233	-0.197386	-0.197386	-0.138233	-0.229416	-0.271708	-0.079305	...	0.870771	-0.870771	-0.197386	-0.179605	-0.733799	1.091687	-0.37
3	0.921319	1.312152	-1.054724	-0.138233	-0.197386	-0.197386	-0.138233	-0.229416	-0.271708	-0.079305	...	-1.148408	1.148408	-0.197386	-0.179605	1.362770	-0.916013	-0.37
4	-0.439410	-0.095388	0.425590	-0.138233	-0.197386	-0.197386	-0.138233	-0.229416	-0.271708	-0.079305	...	0.870771	-0.870771	-0.197386	-0.179605	-0.733799	1.091687	-0.37

5 rows × 37 columns

In [34]:
```python
model = LinearRegression()
model.fit(X_train,y_train)
```

Out[34]:
```
LinearRegression()
```

In [35]:
```python
y_pred = model.predict(X_test)
```

In [36]:
```python
mse = mean_squared_error(y_test,y_pred)
print(f"Mean Squared Error : {mse:0.2f}")

rmse = np.sqrt(mean_squared_error(y_test,y_pred))
print(f"Root Mean Squared Error : {rmse:0.2f}")

mae = mean_absolute_error(y_test,y_pred)
print(f"Mean Absolute Error : {mae:0.2f}")

r2score = r2_score(y_test,y_pred)
print(f"R2 Score: {r2score:0.2f}")
```

```
Mean Squared Error : 6364593.06
Root Mean Squared Error : 2522.81
Mean Absolute Error : 1636.91
R2 Score: 0.93
```

RandomForestRegressor

In [37]:
```python
from sklearn.ensemble import RandomForestRegressor
```

In [38]:
```python
X_train, X_test, y_train, y_test = train_test_split(X,y, test_size=0.2, random_state=99)
```

In [39]:
```python
model = RandomForestRegressor(n_estimators=10)
model.fit(X_train, y_train)
print(f'Train score : {model.score(X_train,y_train)}')
```

```
Train score : 0.9786217304356867
```

In [40]:
```python
y_pred = model.predict(X_test)
r2score = r2_score(y_test,y_pred)
print(f'Test Score  : {r2score:0.2f}')
```

```
Test Score  : 0.95
```

In [41]:
```python
mse = mean_squared_error(y_test,y_pred)
print("MSE  : ",mse)
print("RMSE : ", np.sqrt(mse))
```

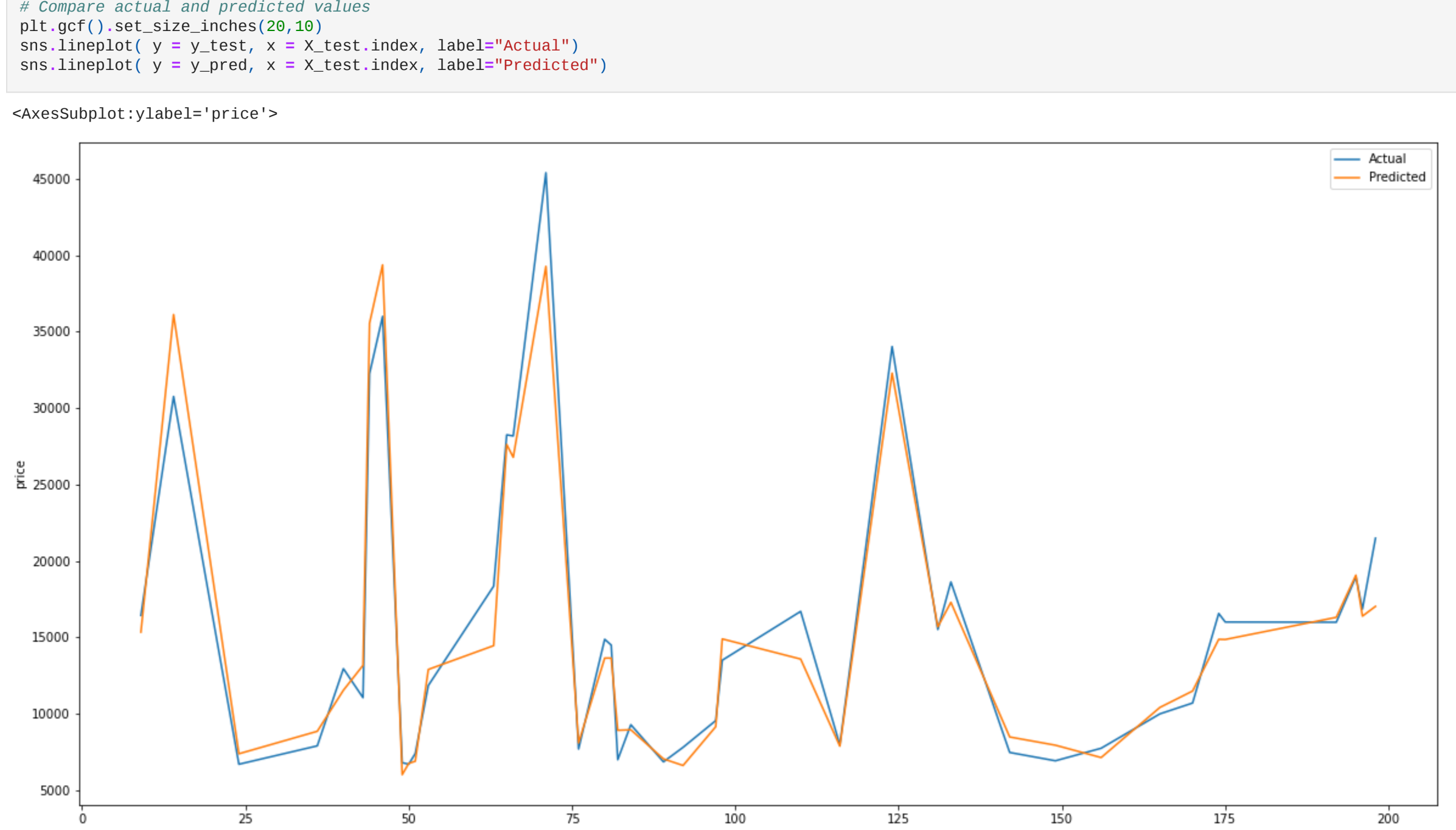
```
MSE  :  4122874.6722222227
RMSE :  2030.4863142169224
```

In [42]:
```python
for f,v in sorted(zip (X_train.columns, model.feature_importances_),key = lambda t : t[1], reverse = True):
      print(f"{f:30} {v:0.2f}")
```

```
engine-size                    0.50
curb-weight                    0.35
highway-mpg                    0.09
make_bmw                       0.01
make_volvo                     0.01
body-style_sedan               0.01
make_audi                      0.00
make_toyota                    0.00
fuel-type_gas                  0.00
drive-wheels_fwd               0.00
fuel-type_diesel               0.00
body-style_hatchback           0.00
num-of-doors_two               0.00
make_peugot                    0.00
body-style_hardtop             0.00
body-style_wagon               0.00
body-style_convertible         0.00
make_porsche                   0.00
drive-wheels_rwd               0.00
drive-wheels_4wd               0.00
num-of-doors_four              0.00
make_volkswagen                0.00
make_alfa-romero               0.00
make_mercury                   0.00
make_mitsubishi                0.00
make_isuzu                     0.00
make_mercedes-benz             0.00
make_subaru                    0.00
make_mazda                     0.00
make_honda                     0.00
make_saab                      0.00
make_plymouth                  0.00
make_nissan                    0.00
make_dodge                     0.00
make_jaguar                    0.00
make_renault                   0.00
make_chevrolet                 0.00
```

In [43]:
```python
# Compare actual and predicted values
plt.gcf().set_size_inches(20,10)
sns.lineplot( y = y_test, x = X_test.index, label="Actual")
sns.lineplot( y = y_pred, x = X_test.index, label="Predicted")
```

Out[43]:
```
<AxesSubplot:ylabel='price'>
```



SGDRegressor

In [44]:
```python
from sklearn.linear_model import SGDRegressor
```

In [45]:
```python
X_mini = X[['curb-weight','engine-size','highway-mpg']]
```

In [46]:
```python
X_train, X_test, y_train, y_test = train_test_split(X,y, test_size=0.2, random_state=99)
```

In [47]:
```python
from sklearn.preprocessing import StandardScaler
scaler = StandardScaler()
```

In [48]:
```python
## use same scale for X_train and X_test
scaler.fit(X_train)
X_train = scaler.transform(X_train)
X_test = scaler.transform(X_test)
```

In [49]:
```python
model = SGDRegressor(random_state=100)
model.fit(X_train, y_train)
print(f'Train score : {model.score(X_train,y_train)}')
```

```
Train score : 0.9270594276291244
```

In [50]:
```python
y_pred = model.predict(X_test)
r2score = r2_score(y_test,y_pred)
print(f'Test Score  : {r2score:0.2f}')
```

```
Test Score  : 0.93
```

In [51]:
```python
mse = mean_squared_error(y_test,y_pred)
print("MSE  : ",mse)
print("RMSE : ", np.sqrt(mse))
```

```
MSE  :  6142786.368307506
RMSE :  2478.464518266805
```

In [ ]: