In [1]:
```
import pandas as pd
import warnings
warnings.filterwarnings('ignore')
data=pd.read_csv("/home/placement/Downloads/fiat500.csv") #reading datafile
print(data)
```

```
        ID   model  engine_power  age_in_days      km  previous_owners  \
0        1  lounge            51          882   25000                1   
1        2     pop            51         1186   32500                1   
2        3   sport            74         4658  142228                1   
3        4  lounge            51         2739  160000                1   
4        5     pop            73         3074  106880                1   
...    ...     ...           ...          ...     ...              ...   
1533  1534   sport            51         3712  115280                1   
1534  1535  lounge            74         3835  112000                1   
1535  1536     pop            51         2223   60457                1   
1536  1537  lounge            51         2557   80750                1   
1537  1538     pop            51         1766   54276                1   

            lat        lon  price  
0     44.907242   8.611560   8900  
1     45.666359  12.241890   8800  
2     45.503300  11.417840   4200  
3     40.633171  17.634609   6000  
4     41.903221  12.495650   5700  
...         ...        ...    ...  
1533  45.069679   7.704920   5200  
1534  45.845692   8.666870   4600  
1535  45.481541   9.413480   7500  
1536  45.000702   7.682270   5990  
1537  40.323410  17.568270   7900  

[1538 rows x 9 columns]
```

In [2]:
```
data.head(10)
```

Out[2]:

	ID	model	engine_power	age_in_days	km	previous_owners	lat	lon	price
0	1	lounge	51	882	25000	1	44.907242	8.611560	8900
1	2	pop	51	1186	32500	1	45.666359	12.241890	8800
2	3	sport	74	4658	142228	1	45.503300	11.417840	4200
3	4	lounge	51	2739	160000	1	40.633171	17.634609	6000
4	5	pop	73	3074	106880	1	41.903221	12.495650	5700
5	6	pop	74	3623	70225	1	45.000702	7.682270	7900
6	7	lounge	51	731	11600	1	44.907242	8.611560	10750
7	8	lounge	51	1521	49076	1	41.903221	12.495650	9190
8	9	sport	73	4049	76000	1	45.548000	11.549470	5600
9	10	sport	51	3653	89000	1	45.438301	10.991700	6000

In [3]:
```
data.columns
```

Out[3]:
```
Index(['ID', 'model', 'engine_power', 'age_in_days', 'km', 'previous_owners',
       'lat', 'lon', 'price'],
      dtype='object')
```

In [4]:
```
data.shape
```

Out[4]:
```
(1538, 9)
```

In [5]:
```
data.describe()
```

Out[5]:

	ID	engine_power	age_in_days	km	previous_owners	lat	lon	price
count	1538.000000	1538.000000	1538.000000	1538.000000	1538.000000	1538.000000	1538.000000	1538.000000
mean	769.500000	51.904421	1650.980494	53396.011704	1.123537	43.541361	11.563428	8576.003901
std	444.126671	3.988023	1289.522278	40046.830723	0.416423	2.133518	2.328190	1939.958641
min	1.000000	51.000000	366.000000	1232.000000	1.000000	36.855839	7.245400	2500.000000
25%	385.250000	51.000000	670.000000	20006.250000	1.000000	41.802990	9.505090	7122.500000
50%	769.500000	51.000000	1035.000000	39031.000000	1.000000	44.394096	11.869260	9000.000000
75%	1153.750000	51.000000	2616.000000	79667.750000	1.000000	45.467960	12.769040	10000.000000
max	1538.000000	77.000000	4658.000000	235000.000000	4.000000	46.795612	18.365520	11100.000000

Removing unwanted columns

In [6]:
```
data1=data.drop(columns=["ID","lat","lon"])
```

In [7]:
```
data1
```

Out[7]:

	model	engine_power	age_in_days	km	previous_owners	price
0	lounge	51	882	25000	1	8900
1	pop	51	1186	32500	1	8800
2	sport	74	4658	142228	1	4200
3	lounge	51	2739	160000	1	6000
4	pop	73	3074	106880	1	5700
...	...	...	...	...	...	...
1533	sport	51	3712	115280	1	5200
1534	lounge	74	3835	112000	1	4600
1535	pop	51	2223	60457	1	7500
1536	lounge	51	2557	80750	1	5990
1537	pop	51	1766	54276	1	7900

1538 rows × 6 columns

In [8]:
```
data1=pd.get_dummies(data1)
```

In [9]:
```
data1
```

Out[9]:

	engine_power	age_in_days	km	previous_owners	price	model_lounge	model_pop	model_sport
0	51	882	25000	1	8900	1	0	0
1	51	1186	32500	1	8800	0	1	0
2	74	4658	142228	1	4200	0	0	1
3	51	2739	160000	1	6000	1	0	0
4	73	3074	106880	1	5700	0	1	0
...	...	...	...	...	...	...	...	...
1533	51	3712	115280	1	5200	0	0	1
1534	74	3835	112000	1	4600	1	0	0
1535	51	2223	60457	1	7500	0	1	0
1536	51	2557	80750	1	5990	1	0	0
1537	51	1766	54276	1	7900	0	1	0

1538 rows × 8 columns

In [10]:
```
data1.shape
```

Out[10]:
```
(1538, 8)
```

remove the actual value from the dataframe

In [11]:
```
y=data1['price']
x=data1.drop(columns='price')
```

In [12]:
```
x
```

Out[12]:

	engine_power	age_in_days	km	previous_owners	model_lounge	model_pop	model_sport
0	51	882	25000	1	1	0	0
1	51	1186	32500	1	0	1	0
2	74	4658	142228	1	0	0	1
3	51	2739	160000	1	1	0	0
4	73	3074	106880	1	0	1	0
...	...	...	...	...	...	...	...
1533	51	3712	115280	1	0	0	1
1534	74	3835	112000	1	1	0	0
1535	51	2223	60457	1	0	1	0
1536	51	2557	80750	1	1	0	0
1537	51	1766	54276	1	0	1	0

1538 rows × 7 columns

In [13]:
```
y
```

Out[13]:
```
0       8900
1       8800
2       4200
3       6000
4       5700
        ...
1533    5200
1534    4600
1535    7500
1536    5990
1537    7900
Name: price, Length: 1538, dtype: int64
```

In [14]:
```
#!pip install scikit-learn
```

split the data into training set and testing set

In [15]:
```
from sklearn.model_selection import train_test_split
x_train,x_test,y_train,y_test=train_test_split(x,y,test_size=0.33,random_state=42)# 66% and 33%
```

In [16]:
```
x_test
```

Out[16]:

	engine_power	age_in_days	km	previous_owners	model_lounge	model_pop	model_sport
481	51	3197	120000	2	0	1	0
76	62	2101	103000	1	0	1	0
1502	51	670	32473	1	1	0	0
669	51	913	29000	1	1	0	0
1409	51	762	18800	1	1	0	0
...	...	...	...	...	...	...	...
291	51	701	22000	1	1	0	0
596	51	3347	85500	1	0	1	0
1489	51	366	22148	1	0	1	0
1436	51	1797	61000	1	1	0	0
575	51	366	19112	1	1	0	0

508 rows × 7 columns

In [17]:
```
x_train
```

Out[17]:

	engine_power	age_in_days	km	previous_owners	model_lounge	model_pop	model_sport
527	51	425	13111	1	1	0	0
129	51	1127	21400	1	1	0	0
602	51	2039	57039	1	0	1	0
331	51	1155	40700	1	1	0	0
323	51	425	16783	1	1	0	0
...	...	...	...	...	...	...	...
1130	51	1127	24000	1	1	0	0
1294	51	852	30000	1	1	0	0
860	51	3409	118000	1	0	1	0
1459	51	762	16700	1	1	0	0
1126	51	701	39207	1	1	0	0

1030 rows × 7 columns

In [18]:
```
y_test.head(5)
```

Out[18]:
```
481     7900
76      7900
1502    9400
669     8500
1409    9700
Name: price, dtype: int64
```

In [19]:
```
y_train.head(5)
```

Out[19]:
```
527    9990
129    9500
602    7590
331    8750
323    9100
Name: price, dtype: int64
```

LinearRegression

In [20]:
```
from sklearn.linear_model import LinearRegression
reg=LinearRegression()#creating object of LinearRegression
reg.fit(x_train,y_train)#training and fitting
```

Out[20]:
```
LinearRegression()
```

In a Jupyter environment, please rerun this cell to show the HTML representation or trust the notebook.
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In [55]:
```
y_pred_regression=reg.predict(x_test) #predict the price using x_test data
```

In [56]:
```
y_pred_regression
```

Out[56]:
```
array([ 5867.6503378 ,  7133.70142341,  9866.35776216,  9723.28874535,
       10039.59101162,  9654.07582608,  9673.14563045, 10118.70728123,
        9903.85952664,  9351.55828437, 10434.34963575,  7732.26255693,
        7698.67240131,  6565.95240435,  9662.90103518, 10373.20344286,
        9599.94844451,  7699.34400418,  4941.33017994, 10455.2719478 ,
       10370.51555682, 10391.60424404,  7529.06622456,  9952.37340054,
        7006.13845729,  9000.1780961 ,  4798.36770637,  6953.10376491,
        7810.39767825,  9623.80497535,  7333.52158317,  5229.18705519,
        5398.21541073,  5157.65652129,  8948.63632836,  5666.62365159,
        9822.1231461 ,  8258.46551788,  6279.2040404 ,  8457.38443276,
        9773.86444066,  6767.04074749,  9182.99904787, 10210.05195479,
        8694.90545226, 10328.43369248,  9069.05761443,  8866.7826029 ,
        7058.39787506,  9073.33877162,  9412.68162121, 10293.69451263,
       10072.49011135,  6748.5794244 ,  9785.95841801,  9354.09969973,
        9507.9444386 , 10443.01608254,  9795.31884316,  7197.84932877,
       10108.31707235,  7009.6597206 ,  9853.90699412,  7146.87414965,
        6417.69133992,  9996.97382441,  9781.18795953,  8515.83255277,
        8456.30006203,  6499.76668237,  7768.57829985,  6832.86406122,
        8347.96113362, 10439.02404036,  7356.43463051,  8562.56562053,
```

In [57]:
```
from sklearn.metrics import r2_score #to know the efficiency bw the predicted price
r2_score(y_test,y_pred_regression)
```

Out[57]:
```
0.8415526986865394
```

In [58]:
```
from sklearn.metrics import mean_squared_error#calaculating mse
mean_squared_error(y_test,y_pred_regression)
```

Out[58]:
```
581887.727391353
```

In [59]:
```
import math
a=581887.727391353
print(math.sqrt(a))
```

```
762.8156575420782
```

In [60]:
```
y_test.head(10)
```

Out[60]:
```
481      7900
76       7900
1502     9400
669      8500
1409     9700
1414     9900
1089     9900
1507     9950
970     10700
1198     8999
Name: price, dtype: int64
```

In [61]:
```
results=pd.DataFrame(columns=['Price','Predicted']) #create datafame for price and predicted
results['Price']=y_test
results['Predicted']=y_pred_regression
results=results.reset_index()   #remove the index as ID values
results['id']=results.index
```

In [62]:
```
results
```

Out[62]:

	index	Price	Predicted	id
0	481	7900	5867.650338	0
1	76	7900	7133.701423	1
2	1502	9400	9866.357762	2
3	669	8500	9723.288745	3
4	1409	9700	10039.591012	4
...	...	...	...	...
503	291	10900	10032.665135	503
504	596	5699	6281.536277	504
505	1489	9500	9986.327508	505
506	1436	6990	8381.517020	506
507	575	10900	10371.142553	507

508 rows × 4 columns

In [63]:
```
results["Difference"]=results.apply(lambda x:x.Price-x.Predicted,axis=1)#add the column for difference b/w t
```

In [64]:

```
results.head(10)
```

Out[64]:

	index	Price	Predicted	id	Difference
0	481	7900	5867.650338	0	2032.349662
1	76	7900	7133.701423	1	766.298577
2	1502	9400	9866.357762	2	-466.357762
3	669	8500	9723.288745	3	-1223.288745
4	1409	9700	10039.591012	4	-339.591012
5	1414	9900	9654.075826	5	245.924174
6	1089	9900	9673.145630	6	226.854370
7	1507	9950	10118.707281	7	-168.707281
8	970	10700	9903.859527	8	796.140473
9	1198	8999	9351.558284	9	-352.558284

In [65]:
```
results
```

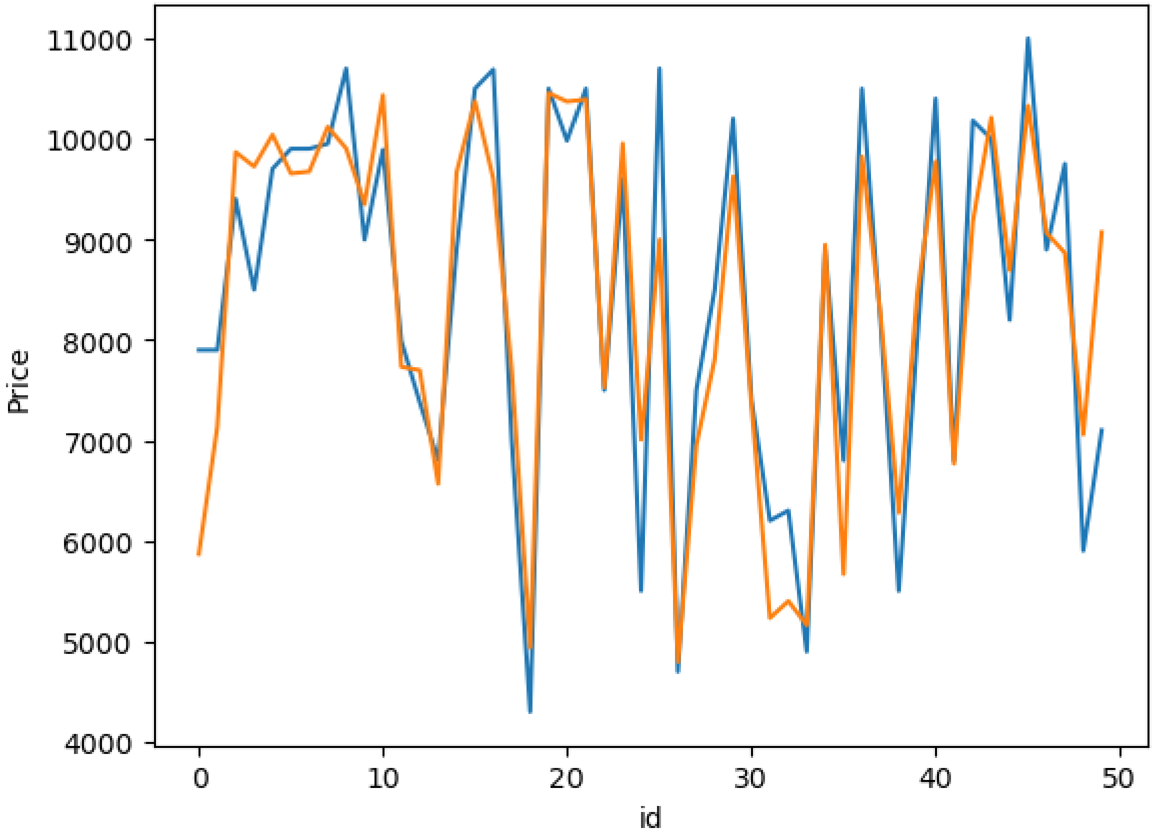
Out[65]:

	index	Price	Predicted	id	Difference
0	481	7900	5867.650338	0	2032.349662
1	76	7900	7133.701423	1	766.298577
2	1502	9400	9866.357762	2	-466.357762
3	669	8500	9723.288745	3	-1223.288745
4	1409	9700	10039.591012	4	-339.591012
...	...	...	...	...	...
503	291	10900	10032.665135	503	867.334865
504	596	5699	6281.536277	504	-582.536277
505	1489	9500	9986.327508	505	-486.327508
506	1436	6990	8381.517020	506	-1391.517020
507	575	10900	10371.142553	507	528.857447

508 rows × 5 columns

plot the data using seaborn and matplotlib libraries

In [33]:
```
import seaborn as sns
import matplotlib.pyplot as plt
sns.lineplot(x='id',y='Price',data=results.head(50))         #actual color=blue
sns.lineplot(x='id',y='Predicted',data=results.head(50))    #predicted color=orange
plt.show()
```



Ridge_Regression

In [34]:
```
from sklearn.model_selection import GridSearchCV
from sklearn.linear_model import Ridge
alpha=[1e-15,1e-10,1e-4,1e-3,1e-2,15,10,20,30]
ridge=Ridge()                                        #creating an object for Ridge
parameters={'alpha':alpha}
ridge_regressor=GridSearchCV(ridge,parameters)
ridge_regressor.fit(x_train,y_train)                 #training and fitting
```

Out[34]:
```
GridSearchCV(estimator=Ridge(),
             param_grid={'alpha': [1e-15, 1e-10, 0.0001, 0.001, 0.01, 15, 10,
                                   20, 30]})
```

In a Jupyter environment, please rerun this cell to show the HTML representation or trust the notebook.
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In [35]:
```
ridge_regressor.best_params_
```

Out[35]:
```
{'alpha': 30}
```

In [66]:
```
ridge=Ridge(alpha=30)
ridge.fit(x_train,y_train)
y_pred_ridge=ridge.predict(x_test)
```

In [67]:
```
from sklearn.metrics import r2_score #to know the efficiency of the predicted price
r2_score(y_test,y_pred_ridge)
```

Out[67]:
```
0.8421969385523054
```

In [68]:
```
from sklearn.metrics import mean_squared_error
Ridge_Error=mean_squared_error(y_pred_ridge,y_test)
Ridge_Error
```

Out[68]: 579521.7970897449

In [69]:
```
results=pd.DataFrame(columns=['Actual','Predicted'])   #create the dataframe for actual and predicted values
results['Actual']=y_test
results['Predicted']=y_pred_ridge
results=results.reset_index()  #remove the index as ID values
results['id']=results.index
```

In [70]:
```
results
```

Out[70]:

	index	Actual	Predicted	id
0	481	7900	5869.741155	0
1	76	7900	7149.563327	1
2	1502	9400	9862.785355	2
3	669	8500	9719.283532	3
4	1409	9700	10035.895686	4
...	...	...	...	...
503	291	10900	10029.070743	503
504	596	5699	6297.833772	504
505	1489	9500	10008.285472	505
506	1436	6990	8375.789449	506
507	575	10900	10368.170257	507

508 rows × 4 columns

In [71]:
```
results["Difference"]=results.apply(lambda x:x.Actual-x.Predicted,axis=1)#add the column for difference b/w
```

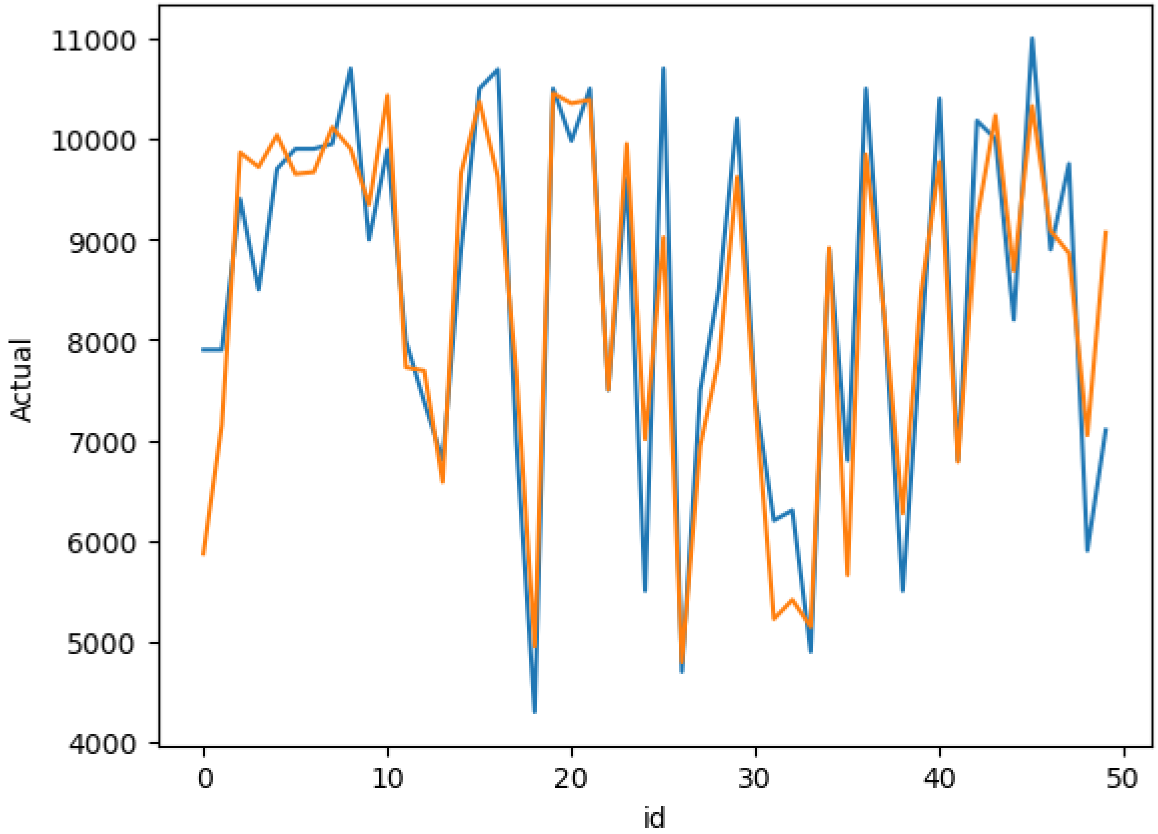
In [72]:
```
results
```

Out[72]:

	index	Actual	Predicted	id	Difference
0	481	7900	5869.741155	0	2030.258845
1	76	7900	7149.563327	1	750.436673
2	1502	9400	9862.785355	2	-462.785355
3	669	8500	9719.283532	3	-1219.283532
4	1409	9700	10035.895686	4	-335.895686
...	...	...	...	...	...
503	291	10900	10029.070743	503	870.929257
504	596	5699	6297.833772	504	-598.833772
505	1489	9500	10008.285472	505	-508.285472
506	1436	6990	8375.789449	506	-1385.789449
507	575	10900	10368.170257	507	531.829743

508 rows × 5 columns

In [73]:
```
import seaborn as sns
import matplotlib.pyplot as plt
sns.lineplot(x='id',y='Actual',data=results.head(50))
sns.lineplot(x='id',y='Predicted',data=results.head(50))
plt.show()
```



ElastiNet model

In [44]:
```
from sklearn.linear_model import ElasticNet
from sklearn.model_selection import GridSearchCV
elastic=ElasticNet()                                    #creating an object for ElasticNet
parameters={'alpha':[1e-15,1e-10,1e-8,1e-4,1e-3,1e-2,15,10,20]}
elastic_regressor=GridSearchCV(elastic,parameters)
elastic_regressor.fit(x_train,y_train)    #training and fitting
```

Out[44]:
```
GridSearchCV(estimator=ElasticNet(),
             param_grid={'alpha': [1e-15, 1e-10, 1e-08, 0.0001, 0.001, 0.01, 15,
                                   10, 20]})
```

In a Jupyter environment, please rerun this cell to show the HTML representation or trust the notebook.
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In [45]:
```
elastic_regressor.best_params_
```

Out[45]:
```
{'alpha': 0.01}
```

In [74]:
```
elastic=ElasticNet(alpha=0.01)
elastic.fit(x_train,y_train)
y_pred_enet=elastic.predict(x_test)
```

In [75]:
```
from sklearn.metrics import mean_squared_error
elastic_Error=mean_squared_error(y_pred_enet,y_test)
elastic_Error
```

Out[75]:
```
581390.7642825295
```

In [76]:
```
from sklearn.metrics import r2_score #to know the efficiency of the predicted price
r2_score(y_test,y_pred_enet)
```

Out[76]: 0.841688021120299

In [77]:
```
results=pd.DataFrame(columns=['Actual','Predicted']) #create the dataframe for actual and predicted values
results['Actual']=y_test
results['Predicted']=y_pred_enet
results=results.reset_index() #remove the index as ID values
results['id']=results.index
```

In [78]:
```
results
```

Out[78]:

	index	Actual	Predicted	id
0	481	7900	5867.742075	0
1	76	7900	7136.527402	1
2	1502	9400	9865.726723	2
3	669	8500	9722.573593	3
4	1409	9700	10038.936496	4
...	...	...	...	...
503	291	10900	10032.030157	503
504	596	5699	6284.484674	504
505	1489	9500	9990.379510	505
506	1436	6990	8380.465651	506
507	575	10900	10370.628731	507

508 rows × 4 columns

In [79]:
```
results["Difference"]=results['Actual']-results['Predicted']#add the column for difference b/w the actual an
```

In [80]:
```
results
```

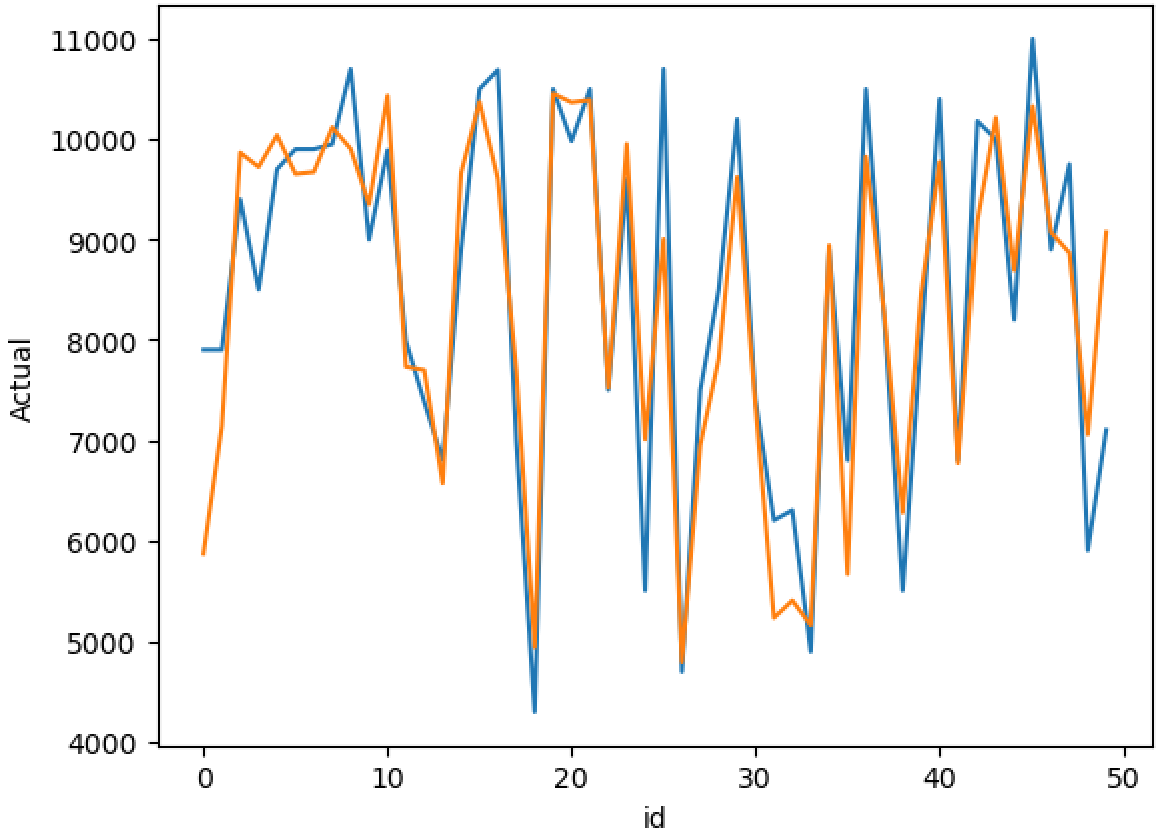
Out[80]:

	index	Actual	Predicted	id	Difference
0	481	7900	5867.742075	0	2032.257925
1	76	7900	7136.527402	1	763.472598
2	1502	9400	9865.726723	2	-465.726723
3	669	8500	9722.573593	3	-1222.573593
4	1409	9700	10038.936496	4	-338.936496
...	...	...	...	...	...
503	291	10900	10032.030157	503	867.969843
504	596	5699	6284.484674	504	-585.484674
505	1489	9500	9990.379510	505	-490.379510
506	1436	6990	8380.465651	506	-1390.465651
507	575	10900	10370.628731	507	529.371269

508 rows × 5 columns

Plot the data using seaborn and matplotlib libraries

In [54]:
```
import seaborn as sns
import matplotlib.pyplot as plt
sns.lineplot(x='id',y='Actual',data=results.head(50))
sns.lineplot(x='id',y='Predicted',data=results.head(50))
plt.show()
```



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