Mercedes-Benz Greener Manufacturing Project 1

October 26, 2022

[193]:
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
%matplotlib inline

import os
import warnings
warnings.filterwarnings("ignore")
```

[194]:
```
train_data = pd.read_csv("ML_train.csv")
test_data = pd.read_csv("ML_test.csv")
```

[195]:
```
train_data.head()
```

[195]:

	ID	y	X0	X1	X2	X3	X4	X5	X6	X8	…	X375	X376	X377	X378	X379	\
0	0	130.81	k	v	at	a	d	u	j	o	…	0	0	1	0	0	
1	6	88.53	k	t	av	e	d	y	l	o	…	1	0	0	0	0	
2	7	76.26	az	w	n	c	d	x	j	x	…	0	0	0	0	0	
3	9	80.62	az	t	n	f	d	x	l	e	…	0	0	0	0	0	
4	13	78.02	az	v	n	f	d	h	d	n	…	0	0	0	0	0	

	X380	X382	X383	X384	X385
0	0	0	0	0	0
1	0	0	0	0	0
2	0	1	0	0	0
3	0	0	0	0	0
4	0	0	0	0	0

[5 rows x 378 columns]

[196]:
```
rows, columns = train_data.shape
print('Rows = ' , rows, 'Columns =' , columns )
```

```
Rows =  4209 Columns = 378
```

[197]:
```
train_data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
```

```
RangeIndex: 4209 entries, 0 to 4208
Columns: 378 entries, ID to X385
dtypes: float64(1), int64(369), object(8)
memory usage: 12.1+ MB
```

[198]:
```
train_data.describe().transpose()
```

[198]:

	count	mean	std	min	25%	50%	75%	max
ID	4209.0	4205.960798	2437.608688	0.00	2095.00	4220.00	6314.00	8417.00
y	4209.0	100.669318	12.679381	72.11	90.82	99.15	109.01	265.32
X10	4209.0	0.013305	0.114590	0.00	0.00	0.00	0.00	1.00
X11	4209.0	0.000000	0.000000	0.00	0.00	0.00	0.00	0.00
X12	4209.0	0.075077	0.263547	0.00	0.00	0.00	0.00	1.00
…	…	…	…	…	…	…	…	…
X380	4209.0	0.008078	0.089524	0.00	0.00	0.00	0.00	1.00
X382	4209.0	0.007603	0.086872	0.00	0.00	0.00	0.00	1.00
X383	4209.0	0.001663	0.040752	0.00	0.00	0.00	0.00	1.00
X384	4209.0	0.000475	0.021796	0.00	0.00	0.00	0.00	1.00
X385	4209.0	0.001426	0.037734	0.00	0.00	0.00	0.00	1.00

[370 rows x 8 columns]

[199]:
```
duplicate = train_data[train_data.duplicated(keep = 'last')]
print("Duplicate Rows :",duplicate)
```

```
Duplicate Rows : Empty DataFrame
Columns: [ID, y, X0, X1, X2, X3, X4, X5, X6, X8, X10, X11, X12, X13, X14, X15,
X16, X17, X18, X19, X20, X21, X22, X23, X24, X26, X27, X28, X29, X30, X31, X32,
X33, X34, X35, X36, X37, X38, X39, X40, X41, X42, X43, X44, X45, X46, X47, X48,
X49, X50, X51, X52, X53, X54, X55, X56, X57, X58, X59, X60, X61, X62, X63, X64,
X65, X66, X67, X68, X69, X70, X71, X73, X74, X75, X76, X77, X78, X79, X80, X81,
X82, X83, X84, X85, X86, X87, X88, X89, X90, X91, X92, X93, X94, X95, X96, X97,
X98, X99, X100, X101, …]
Index: []
```

```
[0 rows x 378 columns]
```

1 1. If for any column(s), the variance is equal to zero, then you need to remove those variable(s).

[200]:
```
variance_0= train_data.var() == 0
variance_0
```

[200]:
```
ID      False
y       False
X10     False
X11      True
X12     False
        …
X380    False
X382    False
X383    False
X384    False
X385    False
Length: 370, dtype: bool
```

[201]:
```
variance = variance_0[variance_0].index.to_list()
variance
```

[201]:
```
['X11',
 'X93',
 'X107',
 'X233',
 'X235',
 'X268',
 'X289',
 'X290',
 'X293',
 'X297',
 'X330',
 'X347']
```

[202]:
```
train_data.drop(variance, axis = 1,inplace=True)
train_data.dtypes.value_counts()
```

[202]:
```
int64      357
object       8
float64      1
dtype: int64
```

[203]:
```
test_data.drop(variance, axis = 1,inplace=True)
test_data.dtypes.value_counts()
```

[203]:
```
int64     357
object      8
dtype: int64
```

2 2.Check for null and unique values for test and train sets.

[204]:
```
train_data.isnull().any().any()
```

[204]:
```
False
```

[205]:
```
test_data.isnull().any().any()
```

[205]:
```
False
```

[206]:
```
train_data.nunique().sort_values(ascending=False)
```

[206]:
```
ID      4209
y       2545
X0        47
X2        44
X5        29
        …
X131       2
X130       2
X129       2
X128       2
X385       2
Length: 366, dtype: int64
```

[207]:
```
test_data.nunique().sort_values(ascending=False)
```

[207]:
```
ID      4209
X0        49
X2        45
X5        32
X1        27
        …
X369       1
X257       1
X258       1
X296       1
X295       1
```

```
Length: 365, dtype: int64
```

3 3. Apply label encoder.

[208]:
```
cols = train_data.columns
num_cols = train_data._get_numeric_data().columns
cat_cols = list(set(cols) - set(num_cols))
cat_cols
```

[208]:
```
['X6', 'X5', 'X1', 'X2', 'X4', 'X3', 'X8', 'X0']
```

[209]:
```
from sklearn.preprocessing import LabelEncoder

class LabelEncoderExt(object):
    def __init__(self):

            self.label_encoder = LabelEncoder()

    def fit(self, data_list):

        self.label_encoder = self.label_encoder.fit(list(data_list) +␣
↪['Unknown'])
        self.classes_ = self.label_encoder.classes_

        return self

    def transform(self, data_list):

        new_data_list = list(data_list)
        for unique_item in np.unique(data_list):
            if unique_item not in self.label_encoder.classes_:
                new_data_list = ['Unknown' if x==unique_item else x for x in␣
↪new_data_list]

        return self.label_encoder.transform(new_data_list)
```

[210]:
```
for c in cat_cols:
    label_encoder = LabelEncoderExt()
    label_encoder.fit(train_data[c])
    train_data[c] =label_encoder.transform(train_data[c])
    test_data[c]=label_encoder.transform(test_data[c])
```

[211]:
```
train_data.head()
```

[211]:

	ID	y	X0	X1	X2	X3	X4	X5	X6	X8	…	X375	X376	X377	X378	\
0	0	130.81	33	24	18	1	4	25	10	15	…	0	0	1	0	
1	6	88.53	33	22	20	5	4	29	12	15	…	1	0	0	0	
2	7	76.26	21	25	35	3	4	28	10	24	…	0	0	0	0	
3	9	80.62	21	22	35	6	4	28	12	5	…	0	0	0	0	
4	13	78.02	21	24	35	6	4	13	4	14	…	0	0	0	0	

	X379	X380	X382	X383	X384	X385
0	0	0	0	0	0	0
1	0	0	0	0	0	0
2	0	0	1	0	0	0
3	0	0	0	0	0	0
4	0	0	0	0	0	0

[5 rows x 366 columns]

4 4. Perform dimensionality reduction.

[212]:
```
y_train = train_data['y']
del train_data['y']

del train_data['ID']

test_data_ID=test_data['ID']
del test_data['ID']
```

[213]:
```
from sklearn.decomposition import PCA
pca = PCA(n_components=8)
pca.fit(train_data)
x_pca = pca.transform(train_data)
x_pca.shape
```

[213]: (4209, 8)

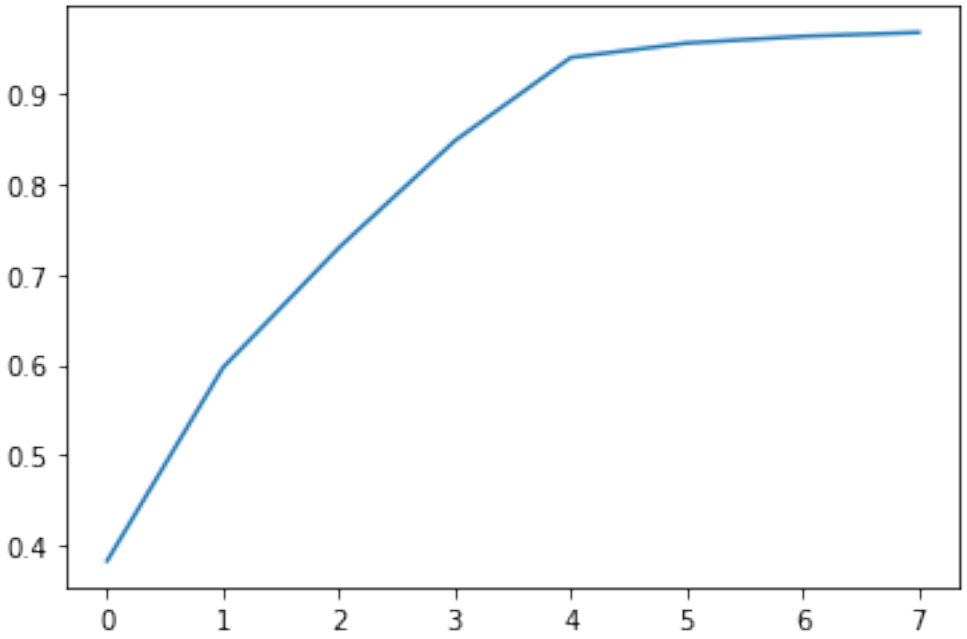
[214]:
```
vr=pca.explained_variance_ratio_
```

[215]:
```
vr.shape
```

[215]: (8,)

[216]:
```
cum_vr=np.cumsum(vr)
plt.plot(cum_vr)
```

[216]: [<matplotlib.lines.Line2D at 0x21c087fb400>]



Aove 90% data effected by 05 Components so, will be considered 05 components

[217]:
```
from sklearn.decomposition import PCA
pca = PCA(n_components=5)
pca.fit(train_data)
x_train_pca = pca.transform(train_data)
x_train_pca.shape
```

[217]: (4209, 5)

[218]:
```
x_test_pca = pca.transform(test_data)
x_test_pca.shape
```

[218]: (4209, 5)

5 5. Predict your test_df values using XGBoost.

[219]:
```
import xgboost as xg
from sklearn.metrics import r2_score
from sklearn.model_selection import train_test_split
from sklearn.metrics import mean_squared_error as MSE

x_train_f, x_valid_f, y_train_f, y_valid_f = train_test_split(x_train_pca,␣
↪y_train, test_size=0.3,random_state=123)
```

[221]:
```
d_train = xg.DMatrix(x_train_f, label=y_train_f)
d_valid = xg.DMatrix(x_valid_f, label=y_valid_f)
d_test = xg.DMatrix(x_test_pca)
```

[222]:
```
param = {'objective': 'reg:linear', 'eta': 0.03, 'max_depth': 4}
xgb_r = xg.train(params=param,dtrain = d_train, num_boost_round = 10)
y_train_pred = xgb_r.predict(d_train)
y_valid_pred = xgb_r.predict(d_valid)
y_test_pred = xgb_r.predict(d_test)
```

```
[05:11:50] WARNING: c:\ci\xgboost-
split_1638290375667\work\src\objective\regression_obj.cu:188: reg:linear is now
deprecated in favor of reg:squarederror.
```

[223]:
```
R_square_train = r2_score(y_train_pred, y_train_f)
R_square_valid = r2_score(y_valid_pred, y_valid_f)
print('R^2 train:', R_square_train)
print('R^2 valid set:', R_square_valid)
```

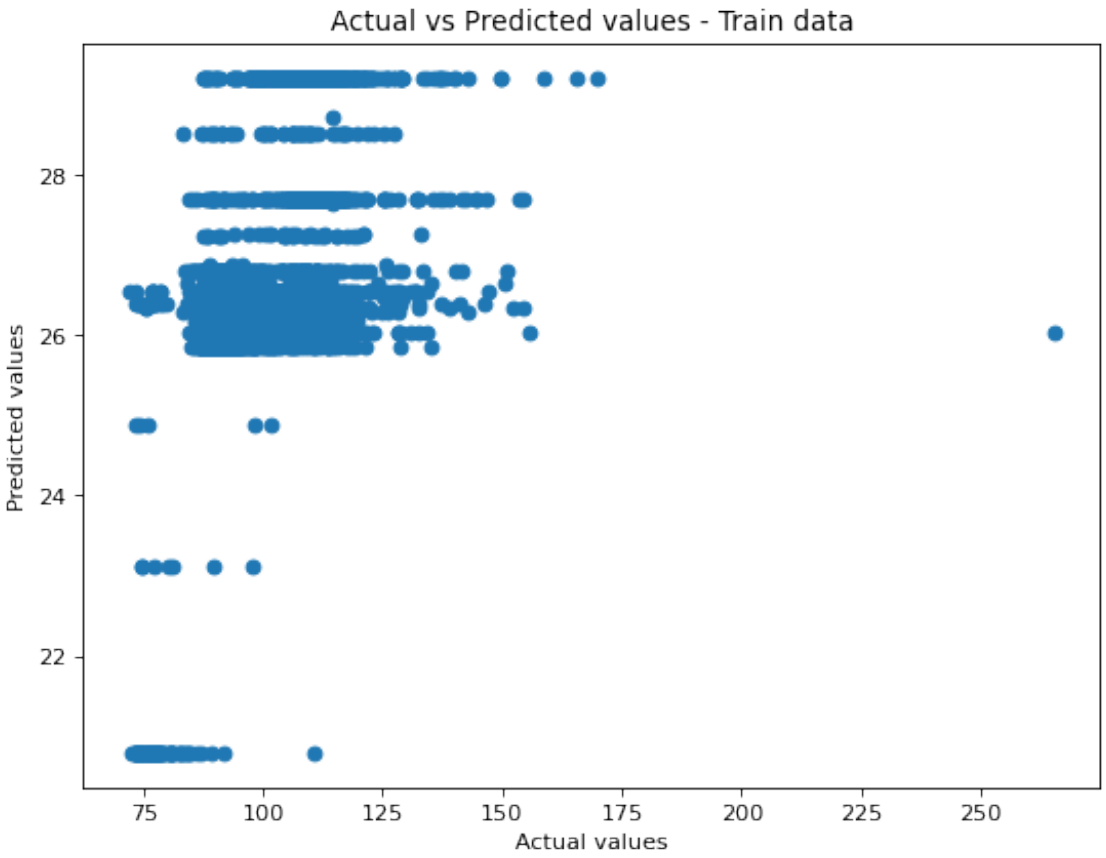
```
R^2 train: -2447.975955655754
R^2 valid set: -2439.5525358364634
```

[224]:
```
# Train set
rmse_train = np.sqrt(MSE(y_train_f, y_train_pred))
print("RMSE of train data: % f" %(rmse_train))

#Valid set
rmse_valid = np.sqrt(MSE(y_valid_f, y_valid_pred))
print("RMSE of valid set data : % f" %(rmse_valid))
```

```
RMSE of train data:  74.899321
RMSE of valid set data :  74.824379
```

[225]:
```
from matplotlib.pyplot import figure
# Actual vs Predicted on Train data
figure(figsize=(8, 6), dpi=80)
plt.scatter(y_train_f,y_train_pred)
plt.title("Actual vs Predicted values - Train data")
plt.xlabel("Actual values")
plt.ylabel("Predicted values")
plt.show()
```


Actual vs Predicted values - Train data
Predicted values
28
26
24
22
75
100
125
150
175
200
225
250
Actual values