In [79]:
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
%matplotlib inline
```

In [80]:
```
train= pd.read_csv('Project_1_Mercedes-Benz_Greener_Manufacturing/train.csv'
test = pd.read_csv('Project_1_Mercedes-Benz_Greener_Manufacturing/test.csv')
```

In [81]:
```
train.head()
```

Out[81]:

	ID	y	X0	X1	X2	X3	X4	X5	X6	X8	...	X375	X376	X377	X378	X379	X38
0	0	130.81	k	v	at	a	d	u	j	o	...	0	0	1	0	0	0
1	6	88.53	k	t	av	e	d	y	l	o	...	1	0	0	0	0	0
2	7	76.26	az	w	n	c	d	x	j	x	...	0	0	0	0	0	0
3	9	80.62	az	t	n	f	d	x	l	e	...	0	0	0	0	0	0
4	13	78.02	az	v	n	f	d	h	d	n	...	0	0	0	0	0	0

5 rows × 378 columns

In [82]:
```
test.head()
```

Out[82]:

	ID	X0	X1	X2	X3	X4	X5	X6	X8	X10	...	X375	X376	X377	X378	X379	X380
0	1	az	v	n	f	d	t	a	w	0	...	0	0	0	1	0	0
1	2	t	b	ai	a	d	b	g	y	0	...	0	0	1	0	0	0
2	3	az	v	as	f	d	a	j	j	0	...	0	0	0	1	0	0
3	4	az	l	n	f	d	z	l	n	0	...	0	0	0	1	0	0
4	5	w	s	as	c	d	y	i	m	0	...	1	0	0	0	0	0

5 rows × 377 columns

In [83]:
```
train.drop(['ID'],axis=1,inplace=True)
train.head()
```

Out[83]:

	y	X0	X1	X2	X3	X4	X5	X6	X8	X10	...	X375	X376	X377	X378	X379	X3
0	130.81	k	v	at	a	d	u	j	o	0	...	0	0	1	0	0	
1	88.53	k	t	av	e	d	y	l	o	0	...	1	0	0	0	0	
2	76.26	az	w	n	c	d	x	j	x	0	...	0	0	0	0	0	
3	80.62	az	t	n	f	d	x	l	e	0	...	0	0	0	0	0	
4	78.02	az	v	n	f	d	h	d	n	0	...	0	0	0	0	0	

5 rows × 377 columns

In [84]:
```
test.drop(['ID'],axis=1,inplace=True)
test.head()
```

Out[84]:

	X0	X1	X2	X3	X4	X5	X6	X8	X10	X11	...	X375	X376	X377	X378	X379	X380
0	az	v	n	f	d	t	a	w	0	0	...	0	0	0	1	0	0
1	t	b	ai	a	d	b	g	y	0	0	...	0	0	1	0	0	0
2	az	v	as	f	d	a	j	j	0	0	...	0	0	0	1	0	0
3	az	l	n	f	d	z	l	n	0	0	...	0	0	0	1	0	0
4	w	s	as	c	d	y	i	m	0	0	...	1	0	0	0	0	0

5 rows × 376 columns

In [85]:
```
ser = pd.Series((train[list(train.columns)[8:]].var()==0))
zero_var_cols = []
non_zero_var_cols = []
for i in range(10,500):
    if list(ser.index).count("X"+str(i))>0:
        if ser["X"+str(i)]==True:
            zero_var_cols.append("X"+str(i))
        else:
            non_zero_var_cols.append("X"+str(i))
```

```
/var/folders/h8/4hprg5r52wqcczhnkxwnfgt00000gn/T/ipykernel_23787/2285104892.
py:1: FutureWarning: Dropping of nuisance columns in DataFrame reductions (w
ith 'numeric_only=None') is deprecated; in a future version this will raise
TypeError.  Select only valid columns before calling the reduction.
  ser = pd.Series((train[list(train.columns)[8:]].var()==0))
```

In [86]:
```
train.drop(zero_var_cols,inplace=True,axis=1)
train.head()
```

Out[86]:

	y	X0	X1	X2	X3	X4	X5	X6	X8	X10	...	X375	X376	X377	X378	X379	X3
0	130.81	k	v	at	a	d	u	j	o	0	...	0	0	1	0	0	
1	88.53	k	t	av	e	d	y	l	o	0	...	1	0	0	0	0	
2	76.26	az	w	n	c	d	x	j	x	0	...	0	0	0	0	0	
3	80.62	az	t	n	f	d	x	l	e	0	...	0	0	0	0	0	
4	78.02	az	v	n	f	d	h	d	n	0	...	0	0	0	0	0	

5 rows × 365 columns

In [87]:
```
test.drop(zero_var_cols,inplace=True,axis=1)
test.head()
```

Out[87]:

	X0	X1	X2	X3	X4	X5	X6	X8	X10	X12	...	X375	X376	X377	X378	X379	X380
0	az	v	n	f	d	t	a	w	0	0	...	0	0	0	1	0	0
1	t	b	ai	a	d	b	g	y	0	0	...	0	0	1	0	0	0
2	az	v	as	f	d	a	j	j	0	0	...	0	0	0	1	0	0
3	az	l	n	f	d	z	l	n	0	0	...	0	0	0	1	0	0
4	w	s	as	c	d	y	i	m	0	0	...	1	0	0	0	0	0

5 rows × 364 columns

In [88]:
```
sum(train.isna().any())
```
Out[88]: 0

In [89]:
```
sum(test.isna().any())
```
Out[89]: 0

In [90]:
```
np.unique(train.dtypes)
```
Out[90]:
```
array([dtype('int64'), dtype('float64'), dtype('O')], dtype=object)
```

In [91]:
```
categorical_cols = ["X0","X1","X2","X3","X4","X5","X6","X8"]
from sklearn.preprocessing import LabelEncoder
le = LabelEncoder()
for col in categorical_cols:
    le_fit =  le.fit(np.union1d(np.unique(train[col]),np.unique(test[col])))
    train[col]=le.transform(train[col])
    test[col]=le.transform(test[col])
```

In [92]:
```
y_train = train[['y']]
```

In [93]:
```
train.drop('y',axis=1,inplace=True)
train.head()
```

Out[93]:

	X0	X1	X2	X3	X4	X5	X6	X8	X10	X12	...	X375	X376	X377	X378	X379	X380
0	37	23	20	0	3	27	9	14	0	0	...	0	0	1	0	0	0
1	37	21	22	4	3	31	11	14	0	0	...	1	0	0	0	0	0
2	24	24	38	2	3	30	9	23	0	0	...	0	0	0	0	0	0
3	24	21	38	5	3	30	11	4	0	0	...	0	0	0	0	0	0
4	24	23	38	5	3	14	3	13	0	0	...	0	0	0	0	0	0

5 rows × 364 columns

In [94]:
```
test.head()
```

Out[94]:

	X0	X1	X2	X3	X4	X5	X6	X8	X10	X12	...	X375	X376	X377	X378	X379	X380
0	24	23	38	5	3	26	0	22	0	0	...	0	0	0	1	0	0
1	46	3	9	0	3	9	6	24	0	0	...	0	0	1	0	0	0
2	24	23	19	5	3	0	9	9	0	0	...	0	0	0	1	0	0
3	24	13	38	5	3	32	11	13	0	0	...	0	0	0	1	0	0
4	49	20	19	2	3	31	8	12	0	0	...	1	0	0	0	0	0

5 rows × 364 columns

In [95]:
```
col_names = list(train.iloc[:,:].columns) # [0,1,2,3,4,5,6,7]
```

In [96]:
```
from sklearn.preprocessing import normalize
from sklearn.preprocessing import StandardScaler
standardScaler = StandardScaler()
train = normalize(train)
test = normalize(test)
train = standardScaler.fit_transform(train)
test = standardScaler.transform(test)
```

In [97]:
```
train = pd.DataFrame(train,columns=col_names)
test = pd.DataFrame(test,columns=col_names)
```

In [98]:
```
train.head()
```

Out[98]:

	X0	X1	X2	X3	X4	X5	X6	X8
0	-0.024634	0.946535	-0.249581	-1.469596	-0.590029	0.965096	0.243500	0.062037
1	-0.137802	0.674721	-0.154896	0.141177	-0.716450	1.238423	0.633395	-0.003078
2	-1.218495	0.802914	0.930978	-0.718179	-0.921356	0.953092	0.009931	0.835999
3	-1.085984	0.689465	1.159887	0.559218	-0.693142	1.165315	0.653477	-1.124608
4	-0.921743	1.071072	1.443609	0.745475	-0.410282	-0.240028	-1.210723	0.030858

5 rows × 364 columns

In [99]:
```
test.head()
```

Out[99]:

	X0	X1	X2	X3	X4	X5	X6	X8
0	-1.134464	0.817244	1.076139	0.504240	-0.776636	0.716000	-2.001191	0.848176
1	0.893821	-0.953582	-1.126072	-1.469596	-0.387743	-0.755110	-0.409663	1.412119
2	-0.288188	1.827053	0.303740	1.463953	0.680840	-1.699863	1.139399	-0.102898
3	-1.086233	-0.053212	1.159457	0.558936	-0.693571	1.355901	0.653108	-0.104632
4	0.422747	0.416328	-0.535453	-0.736904	-0.992447	0.973211	-0.258074	-0.349918

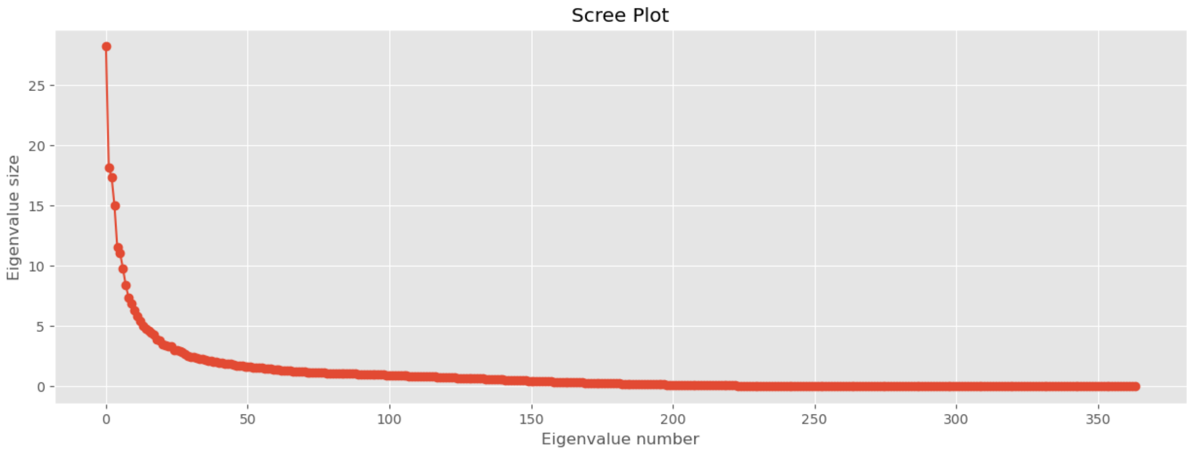
5 rows × 364 columns

In [372…

```
from sklearn.decomposition import PCA
pca = PCA()
x_train = pca.fit_transform(train)
x_test = pca.transform(test)
plt.figure(figsize=(15,5))
plt.style.use("ggplot")
plt.plot(pca.explained_variance_, marker='o')
plt.xlabel("Eigenvalue number")
plt.ylabel("Eigenvalue size")
plt.title("Scree Plot")
```

Out[372]:

```
Text(0.5, 1.0, 'Scree Plot')
```



From above CDF graph we can see that maximum variance can be explained using 25 principal components (the elbow point)

In [425…

```
pca = PCA(n_components=25)
x_train = pca.fit_transform(train)
x_test = pca.transform(test)
```

In [426…

```
import xgboost as xgb
from sklearn.model_selection import train_test_split
from sklearn.metrics import mean_squared_error
from sklearn.metrics import accuracy_score
from sklearn.metrics import r2_score
```

In [427…

```
X_train, X_test, Y_train, Y_test = train_test_split(x_train, y_train,train_s
```

In [428…

```
regressor = xgb.XGBRegressor(n_estimators=20,reg_lambda=40,gamma=600,max_dep
regressor.fit(X_train, Y_train)
pd.DataFrame(regressor.feature_importances_.reshape(1, -1))
```

Out[428]:

	0	1	2	3	4	5	6	7	
0	0.024092	0.226885	0.150361	0.02353	0.044362	0.049162	0.022303	0.019392	0.0202

1 rows × 25 columns

In [429…

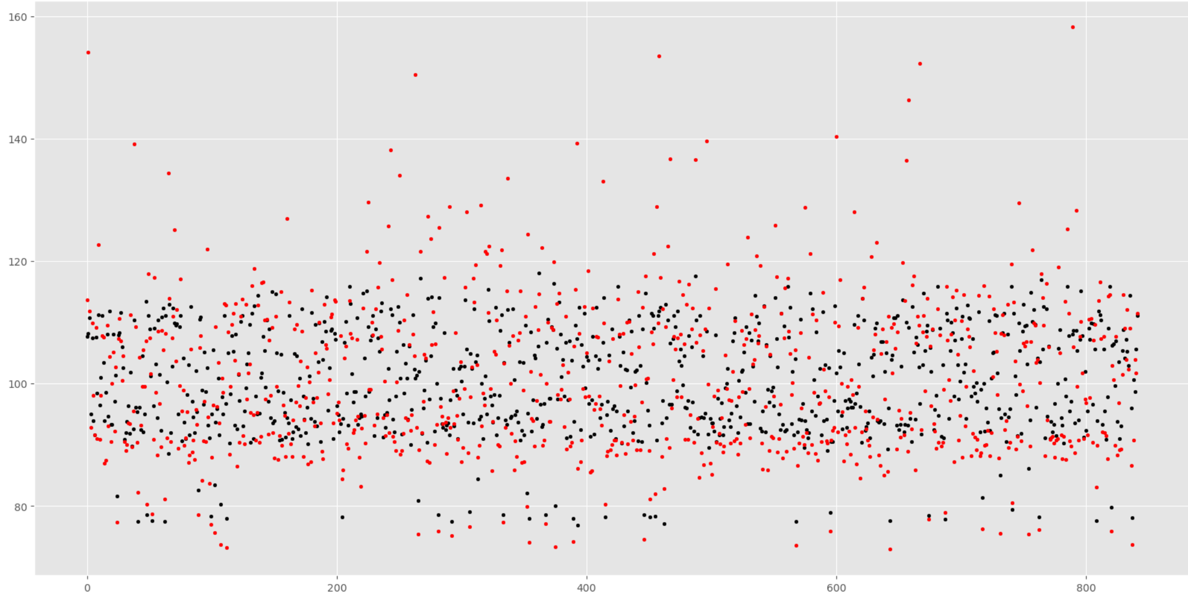
```
Y_pred = regressor.predict(X_test)
print("MSE: " + str(mean_squared_error(Y_test,Y_pred)) + " R2-Score: "+str(r
```

```
MSE: 87.12105784499767 R2-Score: 0.4800502881611578
```

In [430…

```
plt.figure(figsize=(20,10))
plt.scatter(range(0,len(Y_pred)),Y_pred,c='black',s=10)
plt.scatter(range(0,len(Y_test)),Y_test,c='red',s=10)
```

Out[430]: <matplotlib.collections.PathCollection at 0x7fb828c86dc0>



Testing the actual test data provided

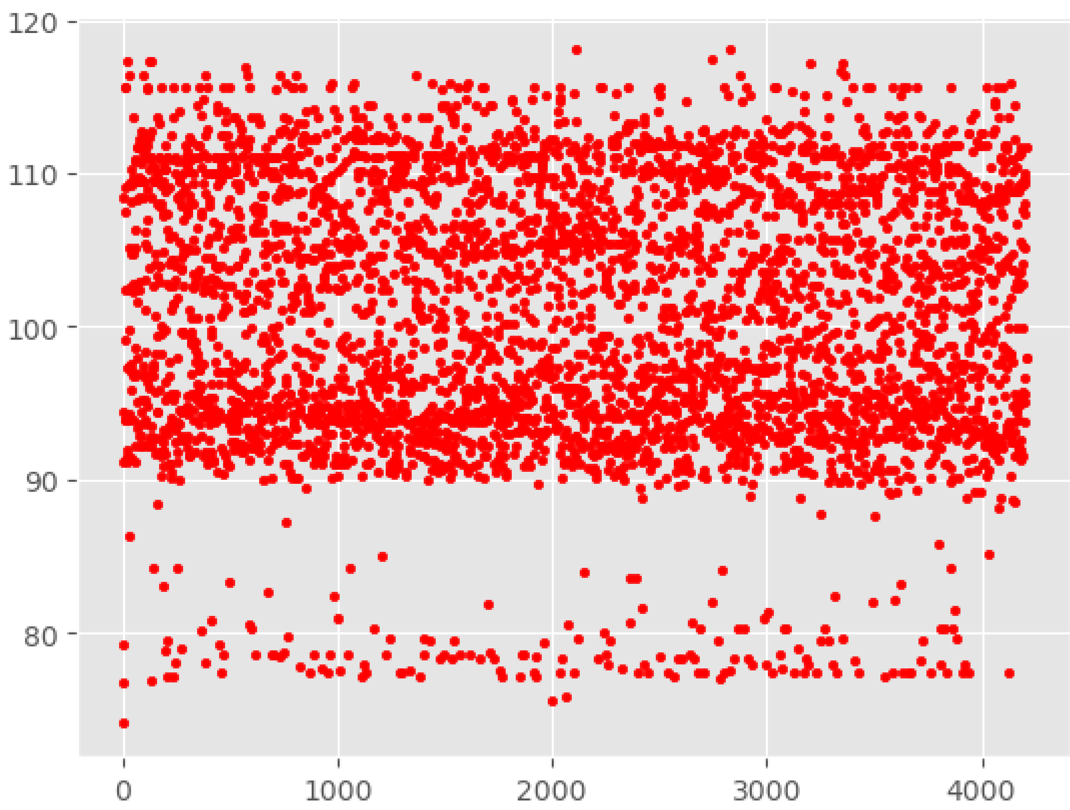
In [432…

```
y_test = regressor.predict(x_test)
```

In [436…

```
plt.scatter(range(0,len(y_test)),y_test,c='red',s=10)
```

Out[436]: <matplotlib.collections.PathCollection at 0x7fb82805d8e0>



In [ ]: