

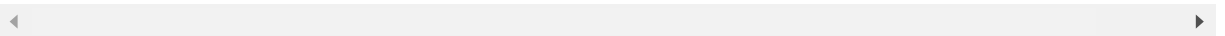
```
In [2]: import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
from sklearn.linear_model import LogisticRegression
```

```
In [3]: df=pd.read_csv(r"D:\New folder\madrid_2015.csv")
df
```

Out[3]:

	date	BEN	CO	EBE	NMHC	NO	NO_2	O_3	PM10	PM25	SO_2	TCH	TOL	
0	2015-10-01 01:00:00	NaN	0.8	NaN	NaN	90.0	82.0	NaN	NaN	NaN	10.0	NaN	NaN	28
1	2015-10-01 01:00:00	2.0	0.8	1.6	0.33	40.0	95.0	4.0	37.0	24.0	12.0	1.83	8.3	28
2	2015-10-01 01:00:00	3.1	NaN	1.8	NaN	29.0	97.0	NaN	NaN	NaN	NaN	NaN	7.1	28
3	2015-10-01 01:00:00	NaN	0.6	NaN	NaN	30.0	103.0	2.0	NaN	NaN	NaN	NaN	NaN	28
4	2015-10-01 01:00:00	NaN	NaN	NaN	NaN	95.0	96.0	2.0	NaN	NaN	9.0	NaN	NaN	28
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
210091	2015-08-01 00:00:00	NaN	0.2	NaN	NaN	11.0	33.0	53.0	NaN	NaN	NaN	NaN	NaN	28
210092	2015-08-01 00:00:00	NaN	0.2	NaN	NaN	1.0	5.0	NaN	26.0	NaN	10.0	NaN	NaN	28
210093	2015-08-01 00:00:00	NaN	NaN	NaN	NaN	1.0	7.0	74.0	NaN	NaN	NaN	NaN	NaN	28
210094	2015-08-01 00:00:00	NaN	NaN	NaN	NaN	3.0	7.0	65.0	NaN	NaN	NaN	NaN	NaN	28
210095	2015-08-01 00:00:00	NaN	NaN	NaN	NaN	1.0	9.0	54.0	29.0	NaN	NaN	NaN	NaN	28

210096 rows × 14 columns



```
In [3]: df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 217872 entries, 0 to 217871
Data columns (total 16 columns):
#   Column      Non-Null Count  Dtype
---  ---
0   date        217872 non-null object
1   BEN         70389 non-null float64
2   CO          216341 non-null float64
3   EBE         57752 non-null float64
4   MXY         42753 non-null float64
5   NMHC        85719 non-null float64
6   NO_2        216331 non-null float64
7   NOx         216318 non-null float64
8   OXY         42856 non-null float64
9   O_3         216514 non-null float64
10  PM10        207776 non-null float64
11  PXY         42845 non-null float64
12  SO_2        216403 non-null float64
13  TCH         85797 non-null float64
14  TOL         70196 non-null float64
15  station     217872 non-null int64
dtypes: float64(14), int64(1), object(1)
memory usage: 26.6+ MB
```

```
In [4]: df1=df.fillna(value=0)
df1
```

Out[4]:

	date	BEN	CO	EBE	MXY	NMHC	NO_2	NOx	OXY	O_3	
0	2001-08-01 01:00:00	0.00	0.37	0.00	0.00	0.00	58.400002	87.150002	0.00	34.529999	105.00
1	2001-08-01 01:00:00	1.50	0.34	1.49	4.10	0.07	56.250000	75.169998	2.11	42.160000	100.50
2	2001-08-01 01:00:00	0.00	0.28	0.00	0.00	0.00	50.660000	61.380001	0.00	46.310001	100.00
3	2001-08-01 01:00:00	0.00	0.47	0.00	0.00	0.00	69.790001	73.449997	0.00	40.650002	69.70
4	2001-08-01 01:00:00	0.00	0.39	0.00	0.00	0.00	22.830000	24.799999	0.00	66.309998	75.10
...	...	...	...	...	...	...	...	...	...	...	...
217867	2001-04-01 00:00:00	10.45	1.81	0.00	0.00	0.00	73.000000	264.399994	0.00	5.200000	47.80
217868	2001-04-01 00:00:00	5.20	0.69	4.56	0.00	0.13	71.080002	129.300003	0.00	13.460000	26.80
217869	2001-04-01 00:00:00	0.49	1.09	0.00	1.00	0.19	76.279999	128.399994	0.35	5.020000	40.70
217870	2001-04-01 00:00:00	5.62	1.01	5.04	11.38	0.00	80.019997	197.000000	2.58	5.840000	37.80
217871	2001-04-01 00:00:00	8.09	1.62	6.66	13.04	0.18	76.809998	206.300003	5.20	8.340000	35.30

217872 rows × 16 columns

In [5]: df1.info()

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 217872 entries, 0 to 217871
Data columns (total 16 columns):
#   Column      Non-Null Count  Dtype
---  ---
0   date        217872 non-null  object
1   BEN         217872 non-null  float64
2   CO          217872 non-null  float64
3   EBE         217872 non-null  float64
4   MXY         217872 non-null  float64
5   NMHC        217872 non-null  float64
6   NO_2        217872 non-null  float64
7   NOx         217872 non-null  float64
8   OXY         217872 non-null  float64
9   O_3         217872 non-null  float64
10  PM10        217872 non-null  float64
11  PXY         217872 non-null  float64
12  SO_2        217872 non-null  float64
13  TCH         217872 non-null  float64
14  TOL         217872 non-null  float64
15  station     217872 non-null  int64
dtypes: float64(14), int64(1), object(1)
memory usage: 26.6+ MB
```

In [6]: df1.columns

```
Out[6]: Index(['date', 'BEN', 'CO', 'EBE', 'MXY', 'NMHC', 'NO_2', 'NOx', 'OXY', 'O_3',
              'PM10', 'PXY', 'SO_2', 'TCH', 'TOL', 'station'],
              dtype='object')
```

```
In [7]: df2=df1[['BEN', 'CO', 'EBE', 'MXY', 'NMHC', 'NO_2', 'NOx', 'OXY', 'O_3',
               'PM10', 'PXY', 'SO_2', 'TCH', 'TOL', 'station']]
df2
```

Out[7]:

	BEN	CO	EBE	MXY	NMHC	NO_2	NOx	OXY	O_3	PM10
0	0.00	0.37	0.00	0.00	0.00	58.400002	87.150002	0.00	34.529999	105.000000
1	1.50	0.34	1.49	4.10	0.07	56.250000	75.169998	2.11	42.160000	100.599998
2	0.00	0.28	0.00	0.00	0.00	50.660000	61.380001	0.00	46.310001	100.099998
3	0.00	0.47	0.00	0.00	0.00	69.790001	73.449997	0.00	40.650002	69.779999
4	0.00	0.39	0.00	0.00	0.00	22.830000	24.799999	0.00	66.309998	75.180000
...	...	...	...	...	...	...	...	...	...	...
217867	10.45	1.81	0.00	0.00	0.00	73.000000	264.399994	0.00	5.200000	47.880001
217868	5.20	0.69	4.56	0.00	0.13	71.080002	129.300003	0.00	13.460000	26.809999
217869	0.49	1.09	0.00	1.00	0.19	76.279999	128.399994	0.35	5.020000	40.770000
217870	5.62	1.01	5.04	11.38	0.00	80.019997	197.000000	2.58	5.840000	37.889999
217871	8.09	1.62	6.66	13.04	0.18	76.800008	206.300003	5.20	8.340000	35.360000

```
In [ ]: sns.pairplot(df2)
```

Out[8]: <seaborn.axisgrid.PairGrid at 0x2e2bb15a040>

```
In [ ]: sns.distplot(df2['station'])
```

```
In [ ]: x=df2[['BEN', 'CO', 'EBE', 'MXY', 'NMHC', 'NO_2', 'NOx', 'O_3', 'PM10', 'PXY',
              y=df2['station']
```

```
In [ ]: from sklearn.model_selection import train_test_split
x_train,x_test,y_train,y_test = train_test_split(x,y,test_size=0.3)
```

## linear

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

```
In [ ]: lr=LinearRegression()
lr.fit(x_train,y_train)
```

```
In [ ]: coeff =pd.DataFrame(lr.coef_,x.columns,columns=["Co-efficient"])
coeff
```

```
In [ ]: print(lr.intercept_)
```

```
In [ ]: prediction =lr.predict(x_test)
        py.scatter(y_test,prediction)
```

```
In [ ]: print(lr.score(x_test,y_test))
```

```
In [ ]: print(lr.score(x_train,y_train))
```

## Ridge

```
In [ ]: from sklearn.linear_model import Ridge,Lasso
```

```
In [ ]: rr=Ridge(alpha=10)
        rr.fit(x_train,y_train)
```

```
In [ ]: rr.score(x_test,y_test)
```

## Lasso

```
In [ ]: la=Lasso(alpha=10)
        la.fit(x_train,y_train)
```

```
In [ ]: la.score(x_test,y_test)
```

## elasticnet

```
In [ ]: from sklearn.linear_model import ElasticNet
        en=ElasticNet()
        en.fit(x_train,y_train)
```

```
In [ ]: print(en.coef_)
```

```
In [ ]: print(en.intercept_)
```

```
In [ ]: print(en.predict(x_test))
```

```
In [ ]: print(en.score(x_test,y_test))
```

## logistic

```
In [ ]: feature_matrix=df2.iloc[:,0:14]
        target_vector=df2.iloc[:, -1]
```

```
In [ ]: feature_matrix=df2[['BEN', 'CO', 'EBE', 'MXY', 'NMHC', 'NO_2', 'NOx', 'O_3', 'PM10', 'PM2.5', 'SO2', 'TSP']]
        y=df2['station']
```

```
In [ ]: feature_matrix.shape
```

```
In [ ]: target_vector.shape
```

```
In [ ]: from sklearn.preprocessing import StandardScaler
```

```
In [ ]: fs=StandardScaler().fit_transform(feature_matrix)
```

```
In [ ]: logr =LogisticRegression()
        logr.fit(fs,target_vector)
```

```
In [ ]: observation=[[1.4,2.3,5.0,11,12,13,14,15,4,5,7,6,7,13]]
```

```
In [ ]: prediction=logr.predict(observation)
        print(prediction)
```

```
In [ ]: logr.classes_
```

```
In [ ]: logr.score(fs,target_vector)
```

```
In [ ]: logr.predict_proba(observation)[0][0]
```

```
In [ ]: logr.predict_proba(observation)[0][1]
```

## random forest

```
In [ ]: from sklearn.ensemble import RandomForestClassifier
        from sklearn.tree import plot_tree
```

```
In [ ]: x=df2.drop('station',axis=1)
        y=df2['station']
```

```
In [ ]: x_train,x_test,y_train,y_test = train_test_split(x,y,test_size=0.70)
```

```
In [ ]: rfc=RandomForestClassifier()  
rfc.fit(x_train,y_train)
```

```
In [ ]: parameters = {'max_depth':[1,2,3,4,5],  
                      'min_samples_leaf':[5,10,15,20,25],  
                      'n_estimators':[10,20,30,40,50]}
```

```
In [ ]: from sklearn.model_selection import GridSearchCV
```

```
In [ ]: grid_search = GridSearchCV(estimator=rfc,param_grid=parameters,cv=2,scoring='a  
grid_search.fit(x_train,y_train)
```

```
In [ ]: grid_search.best_score_
```

```
In [ ]: rfc_best =grid_search.best_estimator_
```

```
In [ ]: py.figure(figsize=(80,50))  
plot_tree(rfc_best.estimators_[5],feature_names=x.columns,filled=True)
```

## conclusion

**The bestfit model is Logistic Regression with score of 0.9102362855254461**

```
In [ ]:
```