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

In [2]:
```
df = pd.read_csv(r"C:\Users\user\Downloads\C10_air\csvs_per_year\csvs_per_year\
df
```

Out[2]:

	date	BEN	CO	EBE	MXY	NMHC	NO_2	NOx	OXY	O_3	PI
0	2004-08-01 01:00:00	NaN	0.66	NaN	NaN	NaN	89.550003	118.900002	NaN	40.020000	39.990
1	2004-08-01 01:00:00	2.66	0.54	2.99	6.08	0.18	51.799999	53.860001	3.28	51.689999	22.950
2	2004-08-01 01:00:00	NaN	1.02	NaN	NaN	NaN	93.389999	138.600006	NaN	20.860001	49.480
3	2004-08-01 01:00:00	NaN	0.53	NaN	NaN	NaN	87.290001	105.000000	NaN	36.730000	31.070
4	2004-08-01 01:00:00	NaN	0.17	NaN	NaN	NaN	34.910000	35.349998	NaN	86.269997	54.080
...	...	...	...	...	...	...	...	...	...	...	
245491	2004-06-01 00:00:00	0.75	0.21	0.85	1.55	0.07	59.580002	64.389999	0.66	33.029999	30.900
245492	2004-06-01 00:00:00	2.49	0.75	2.44	4.57	NaN	97.139999	146.899994	2.34	7.740000	37.689
245493	2004-06-01 00:00:00	NaN	NaN	NaN	NaN	0.13	102.699997	132.600006	NaN	17.809999	22.840
245494	2004-06-01 00:00:00	NaN	NaN	NaN	NaN	0.09	82.599998	102.599998	NaN	NaN	45.630
245495	2004-06-01 00:00:00	3.01	0.67	2.78	5.12	0.20	92.550003	141.000000	2.60	11.460000	24.389

245496 rows × 17 columns

In [3]:
```
df1 = df.fillna(0)
df1
```

Out[3]:

	date	BEN	CO	EBE	MXY	NMHC	NO_2	NOx	OXY	O_3	PI
0	2004-08-01 01:00:00	0.00	0.66	0.00	0.00	0.00	89.550003	118.900002	0.00	40.020000	39.990
1	2004-08-01 01:00:00	2.66	0.54	2.99	6.08	0.18	51.799999	53.860001	3.28	51.689999	22.950
2	2004-08-01 01:00:00	0.00	1.02	0.00	0.00	0.00	93.389999	138.600006	0.00	20.860001	49.480
3	2004-08-01 01:00:00	0.00	0.53	0.00	0.00	0.00	87.290001	105.000000	0.00	36.730000	31.070
4	2004-08-01 01:00:00	0.00	0.17	0.00	0.00	0.00	34.910000	35.349998	0.00	86.269997	54.080
...	...	...	...	...	...	...	...	...	...	...	
245491	2004-06-01 00:00:00	0.75	0.21	0.85	1.55	0.07	59.580002	64.389999	0.66	33.029999	30.900
245492	2004-06-01 00:00:00	2.49	0.75	2.44	4.57	0.00	97.139999	146.899994	2.34	7.740000	37.689
245493	2004-06-01 00:00:00	0.00	0.00	0.00	0.00	0.13	102.699997	132.600006	0.00	17.809999	22.840
245494	2004-06-01 00:00:00	0.00	0.00	0.00	0.00	0.09	82.599998	102.599998	0.00	0.000000	45.630
245495	2004-06-01 00:00:00	3.01	0.67	2.78	5.12	0.20	92.550003	141.000000	2.60	11.460000	24.389

245496 rows × 17 columns

In [4]:
```
df1.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 245496 entries, 0 to 245495
Data columns (total 17 columns):
 #   Column   Non-Null Count   Dtype  
---  ------   --------------   -----  
 0   date     245496 non-null  object 
 1   BEN      245496 non-null  float64
 2   CO       245496 non-null  float64
 3   EBE      245496 non-null  float64
 4   MXY      245496 non-null  float64
 5   NMHC     245496 non-null  float64
 6   NO_2     245496 non-null  float64
 7   NOx      245496 non-null  float64
 8   OXY      245496 non-null  float64
 9   O_3      245496 non-null  float64
 10  PM10     245496 non-null  float64
 11  PM25     245496 non-null  float64
 12  PXY      245496 non-null  float64
 13  SO_2     245496 non-null  float64
 14  TCH      245496 non-null  float64
 15  TOL      245496 non-null  float64
 16  station  245496 non-null  int64  
dtypes: float64(15), int64(1), object(1)
memory usage: 31.8+ MB
```

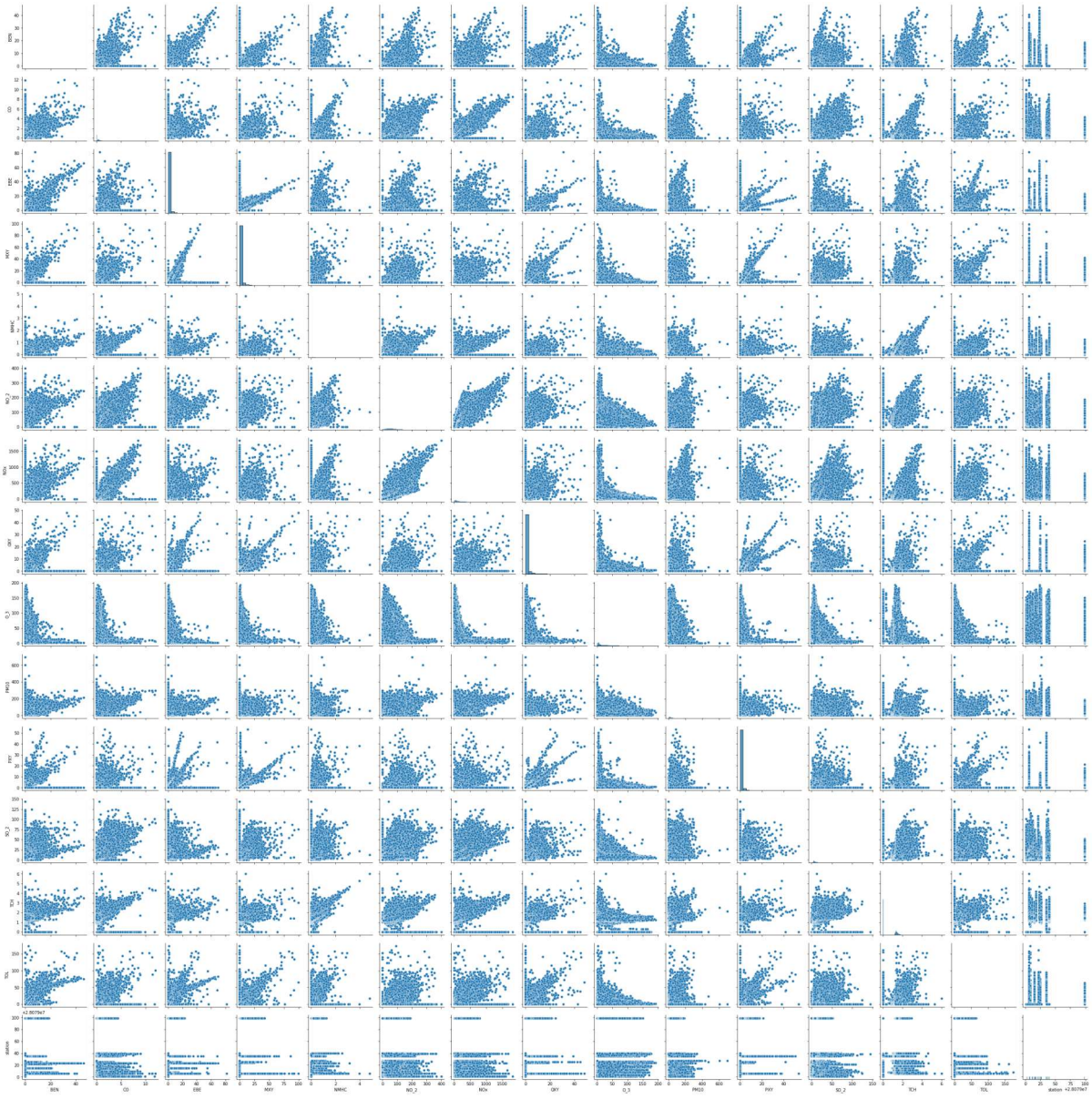
In [5]:
```
df1.columns
```

Out[5]:
```
Index(['date', 'BEN', 'CO', 'EBE', 'MXY', 'NMHC', 'NO_2', 'NOx', 'OXY', 'O_
3',
       'PM10', 'PM25', 'PXY', 'SO_2', 'TCH', 'TOL', 'station'],
      dtype='object')
```

In [6]:
```
df2 = df1[['BEN', 'CO', 'EBE', 'MXY', 'NMHC', 'NO_2', 'NOx', 'OXY', 'O_3',
       'PM10', 'PXY', 'SO_2', 'TCH', 'TOL', 'station']]
```

In [7]:
```
sns.pairplot(df2)
```

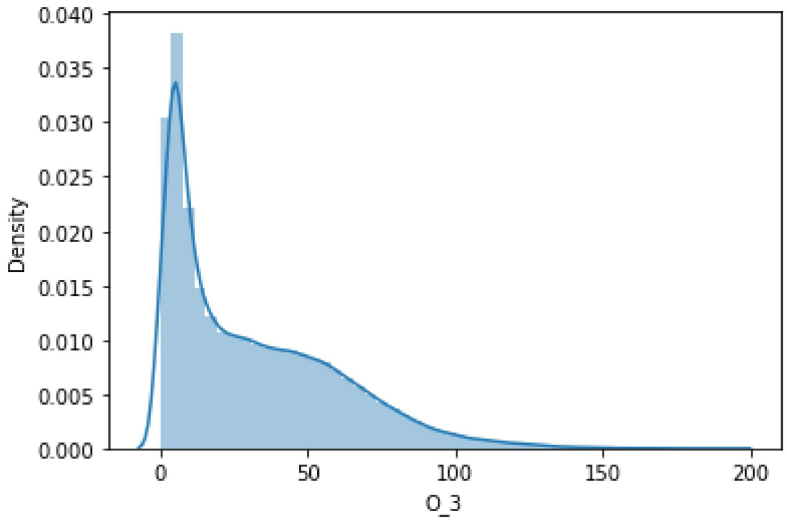
Out[7]:
```
<seaborn.axisgrid.PairGrid at 0x24202788400>
```



In [8]:
```
sns.distplot(df2['O_3'])
```

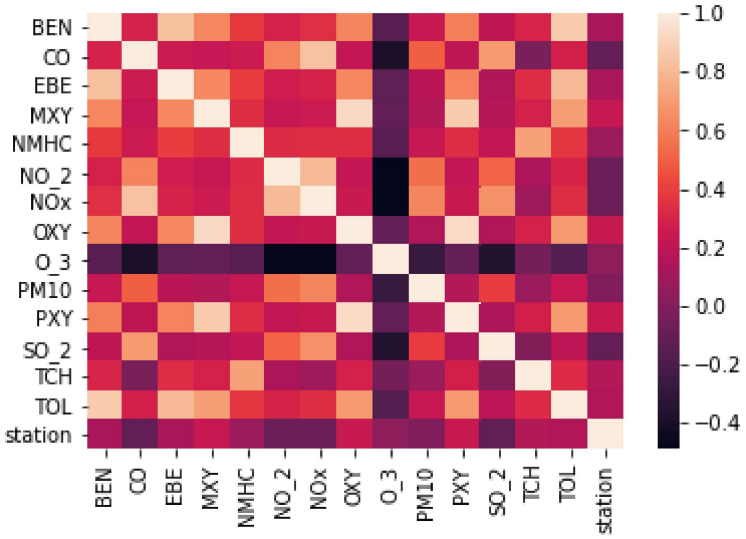
```
C:\ProgramData\Anaconda3\lib\site-packages\seaborn\distributions.py:2557: Fut
ureWarning: `distplot` is a deprecated function and will be removed in a futu
re version. Please adapt your code to use either `displot` (a figure-level fu
nction with similar flexibility) or `histplot` (an axes-level function for hi
stograms).
  warnings.warn(msg, FutureWarning)
```

Out[8]: <AxesSubplot:xlabel='O_3', ylabel='Density'>



In [9]:
```
sns.heatmap(df2.corr())
```

Out[9]: <AxesSubplot:>



Linear Regression

In [10]:
```
x = df2[['BEN', 'CO', 'EBE', 'MXY', 'NMHC', 'NO_2', 'NOx', 'OXY','O_3',
       'PM10', 'PXY', 'SO_2', 'TCH']]
y = df2['TOL']
```

In [11]:
```
from sklearn.model_selection import train_test_split

x_train,x_test,y_train,y_test = train_test_split(x,y,test_size=0.30)
```

In [12]:
```
from sklearn.linear_model import LinearRegression

lr = LinearRegression()
lr.fit(x_train,y_train)
```

Out[12]:
```
LinearRegression()
```

In [13]:
```
print(lr.intercept_)
```

```
0.20679259782500603
```

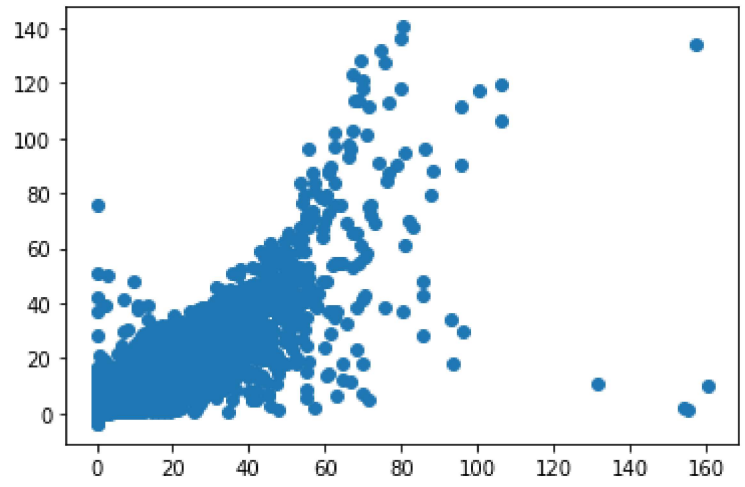
In [14]:
```
coeff = pd.DataFrame(lr.coef_,x.columns,columns=['Co-efficient'])
coeff
```

Out[14]:

	Co-efficient
BEN	2.437536
CO	-0.334180
EBE	0.596188
MXY	0.346661
NMHC	-2.146765
NO_2	0.002495
NOx	0.001137
OXY	-0.268222
O_3	-0.007170
PM10	0.003386
PXY	0.752120
SO_2	0.013198
TCH	0.439801

In [15]:
```
prediction = lr.predict(x_test)
plt.scatter(y_test,prediction)
```

Out[15]:
```
<matplotlib.collections.PathCollection at 0x242143eb790>
```



In [16]:
```
print(lr.score(x_test,y_test))
```

```
0.8152926154780802
```

In [17]:
```
lr.score(x_train,y_train)
```

Out[17]:
```
0.8194457812396877
```

Ridge and Lasso

In [18]:
```
from sklearn.linear_model import Ridge,Lasso
```

In [19]:
```
rr = Ridge(alpha=10)
rr.fit(x_train,y_train)
rr.score(x_train,y_train)
```

Out[19]:
```
0.8194457356820384
```

In [20]:
```
rr.score(x_test,y_test)
```

Out[20]:
```
0.8152917882782502
```

In [21]:
```
ls = Lasso(alpha=10)
ls.fit(x_train,y_train)
ls.score(x_train,y_train)
```

Out[21]:
```
0.2795587021595328
```

In [22]:
```
ls.score(x_test,y_test)
```

Out[22]:
```
0.26896634875436976
```

ElacticNET regression

In [23]:
```
from sklearn.linear_model import ElasticNet
es = ElasticNet()
es.fit(x_train,y_train)
```

Out[23]:
```
ElasticNet()
```

In [24]:
```
print(es.coef_)
```

```
[ 1.50365928 -0.          0.86534291  0.55583419  0.          0.00229866
  0.00241302  0.         -0.00592427  0.00374389  0.10313413  0.
  0.        ]
```

In [25]:
```
print(es.intercept_)
```

```
0.3850909023175828
```

In [26]:
```
print(es.score(x_test,y_test))
```

```
0.7910311436905046
```

In [27]:
```
print(es.score(x_train,y_train))
```

```
0.7966869610105227
```

LogisticRegression

In [28]:
```
from sklearn.linear_model import LogisticRegression
```

In [29]:
```
feature_matrix = df2.iloc[:,0:15]
target_vector = df2.iloc[:,-1]
```

In [30]:
```
feature_matrix.shape
```

Out[30]:
```
(245496, 15)
```

In [31]:
```
from sklearn.preprocessing import StandardScaler
```

In [32]:
```
fs = StandardScaler().fit_transform(feature_matrix)
```

In [33]:
```
logs = LogisticRegression()
logs.fit(fs,target_vector)
```

```
C:\ProgramData\Anaconda3\lib\site-packages\sklearn\linear_model\_logistic.py:
763: ConvergenceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html (https://scikit-learn.org/stable/modules/preprocessing.html)
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression (https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression)
  n_iter_i = _check_optimize_result(
```

Out[33]:
```
LogisticRegression()
```

In [34]:
```
observation = [[1.4,1.5,1.6,2.7,2.3,3.3,2.3,4.1,2.3,4.2,1.2,2.1,4.3,6,2.2]]
prediction = logs.predict(observation)
```

In [35]:
```
print(prediction)
```

```
[28079099]
```

In [36]:
```
logs.classes_
```

Out[36]:
```
array([28079001, 28079003, 28079004, 28079006, 28079007, 28079008,
       28079009, 28079011, 28079012, 28079014, 28079015, 28079016,
       28079017, 28079018, 28079019, 28079021, 28079022, 28079023,
       28079024, 28079025, 28079026, 28079027, 28079035, 28079036,
       28079038, 28079039, 28079040, 28079099], dtype=int64)
```

In [37]:
```
from sklearn.model_selection import train_test_split

x_train,x_test,y_train,y_test = train_test_split(feature_matrix,target_vector,t
```

In [38]:
```
print(logs.score(x_test,y_test))
```

```
0.035737077217613274
```

In [39]:
```
print(logs.score(x_train,y_train))
```

```
0.03579928657468562
```

Conclusion

Ridge regression is bestfit model

Ridge regression is best fit model for dataset madrid_2001. The score of x_train,y_train is 0.8194457356820384 and x_test and y_test score is 0.8152917882782502.

In [ ]: