Time Series Analysis

import libraries

```python
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
from statsmodels.tsa.seasonal import seasonal_decompose
from statsmodels.tsa.stattools import adfuller
from statsmodels.tsa.arima.model import ARIMA
```

Load the Data

```python
aqi=pd.read_csv("C:\mypythonfiles\AQI_Airpollution (1).csv")
aqi.head()
```

```
         Date    Country                          Status  AQI Value
0  21-07-2022    Albania                            Good         14
1  21-07-2022    Algeria                        Moderate         65
2  21-07-2022    Andorra                        Moderate         55
3  21-07-2022     Angola  Unhealthy for Sensitive Groups        113
4  21-07-2022  Argentina                        Moderate         63
```

```python
aqi.isnull().sum()
```

```
Date         0
Country      0
Status       0
AQI Value    0
dtype: int64
```

```python
aqi.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 18227 entries, 0 to 18226
Data columns (total 4 columns):
 #   Column     Non-Null Count  Dtype 
---  ------     --------------  ----- 
 0   Date       18227 non-null  object
 1   Country    18227 non-null  object
 2   Status     18227 non-null  object
 3   AQI Value  18227 non-null  int64 
dtypes: int64(1), object(3)
memory usage: 569.7+ KB
```

```python
print(aqi[aqi['Date'].isna()])
```

```
Empty DataFrame
Columns: [Date, Country, Status, AQI Value]
Index: []
```

```
aqi['Date'] = pd.to_datetime(aqi['Date'],errors = 'coerce')
aqi.info()
```

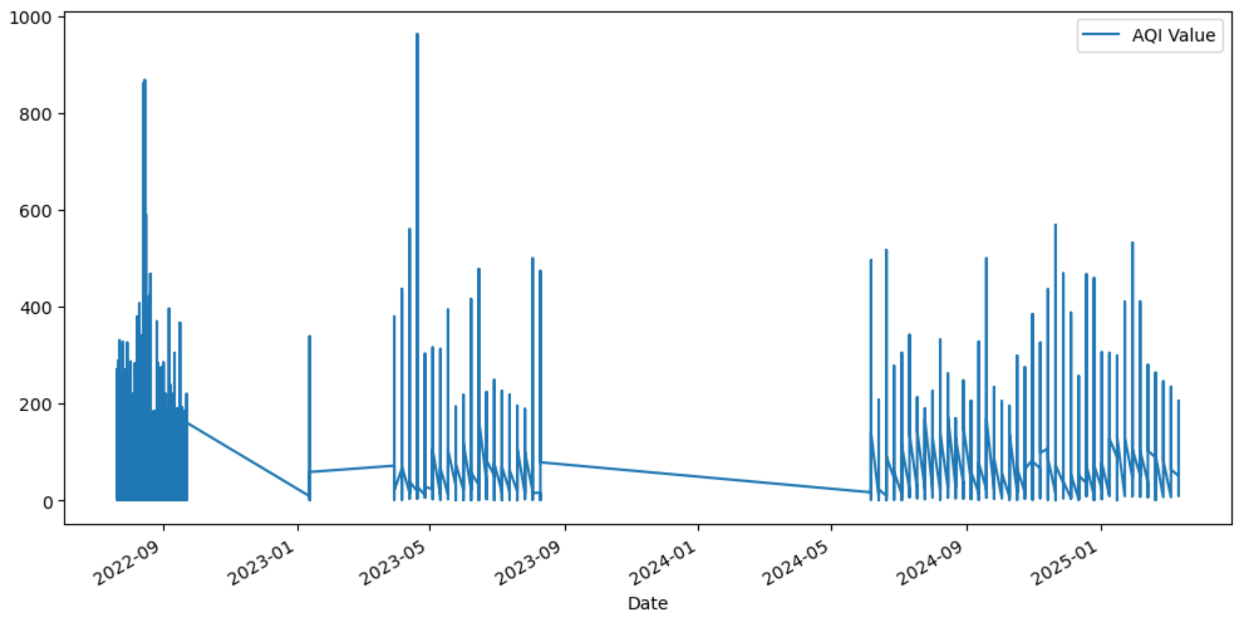
```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 18227 entries, 0 to 18226
Data columns (total 4 columns):
 #   Column     Non-Null Count  Dtype
---  ------     --------------  -----
 0   Date       18227 non-null  datetime64[ns]
 1   Country    18227 non-null  object
 2   Status     18227 non-null  object
 3   AQI Value  18227 non-null  int64
dtypes: datetime64[ns](1), int64(1), object(2)
memory usage: 569.7+ KB
```

```
C:\Users\DELL\AppData\Local\Temp\ipykernel_8644\3707336382.py:1:
UserWarning: Parsing dates in %d-%m-%Y format when dayfirst=False (the
default) was specified. Pass `dayfirst=True` or specify a format to
silence this warning.
  aqi['Date'] = pd.to_datetime(aqi['Date'],errors = 'coerce')
```

```
aqi.set_index("Date",inplace=True)
aqi.info()
```

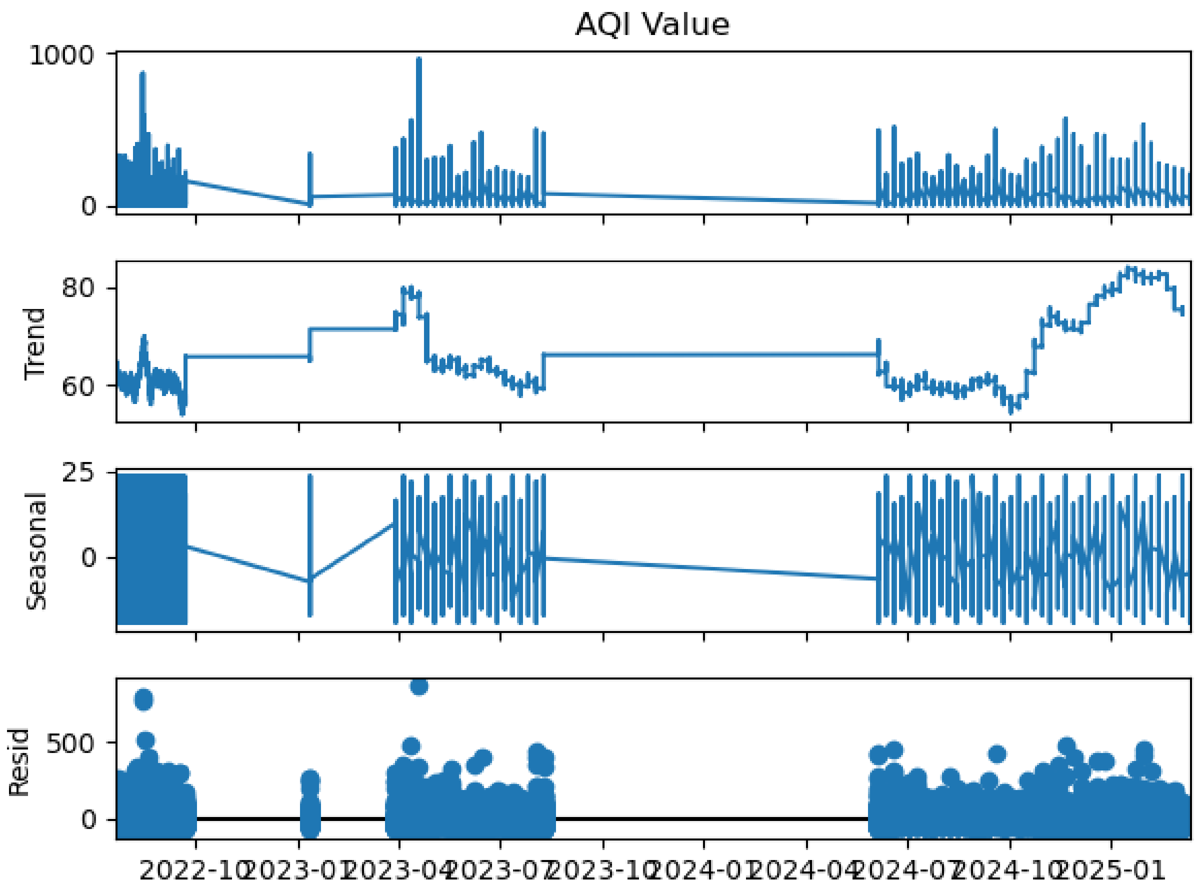
```
<class 'pandas.core.frame.DataFrame'>
DatetimeIndex: 18227 entries, 2022-07-21 to 2025-03-13
Data columns (total 3 columns):
 #   Column     Non-Null Count  Dtype
---  ------     --------------  -----
 0   Country    18227 non-null  object
 1   Status     18227 non-null  object
 2   AQI Value  18227 non-null  int64
dtypes: int64(1), object(2)
memory usage: 569.6+ KB
```

```
aqi.plot(figsize=(12,6),subplots=True)
plt.show()
```



The graph represents the AQI(Air quality index) values from mid of 2022 to 2025. There are gaps in data where values drop to zero. High AQI values are seen in mid-2022, early 2023, and mid-2024 with worsening air quality. These spikes suggest poor air quality may be due to industrial activities.

```
adfuller_result=adfuller(aqi['AQI Value'])

print(adfuller_result)

(-15.215400453061477, 5.579625689083851e-28, 45, 18181, {'1%': -
3.4307097284809336, '5%': -2.86169898646948, '10%': -
2.566854624305701}, 193290.32233171744)

if adfuller_result[1]<0.05:
    print("Stationary")
else:
    print("Non Stationary")

Stationary

decomp=seasonal_decompose(aqi['AQI
Value'],model='additive',period=365)

decomp.plot()
plt.show()
```



```
len(aqi)
```

```
18227
```

```
print(len(aqi)*0.8)
```

```
14581.6
```

```
train = aqi.iloc[0:14581]
test= aqi.iloc[14581:]
```

```
mymodel=ARIMA(train['AQI Value'],order=(1,1,1))
```

```
C:\Users\DELL\anaconda3\Lib\site-packages\statsmodels\tsa\base\
tsa_model.py:473: ValueWarning: A date index has been provided, but it
has no associated frequency information and so will be ignored when
e.g. forecasting.
  self._init_dates(dates, freq)
C:\Users\DELL\anaconda3\Lib\site-packages\statsmodels\tsa\base\
tsa_model.py:473: ValueWarning: A date index has been provided, but it
has no associated frequency information and so will be ignored when
e.g. forecasting.
  self._init_dates(dates, freq)
```

```
C:\Users\DELL\anaconda3\Lib\site-packages\statsmodels\tsa\base\
tsa_model.py:473: ValueWarning: A date index has been provided, but it
has no associated frequency information and so will be ignored when
e.g. forecasting.
  self._init_dates(dates, freq)
```

```
mymodel=mymodel.fit()
```

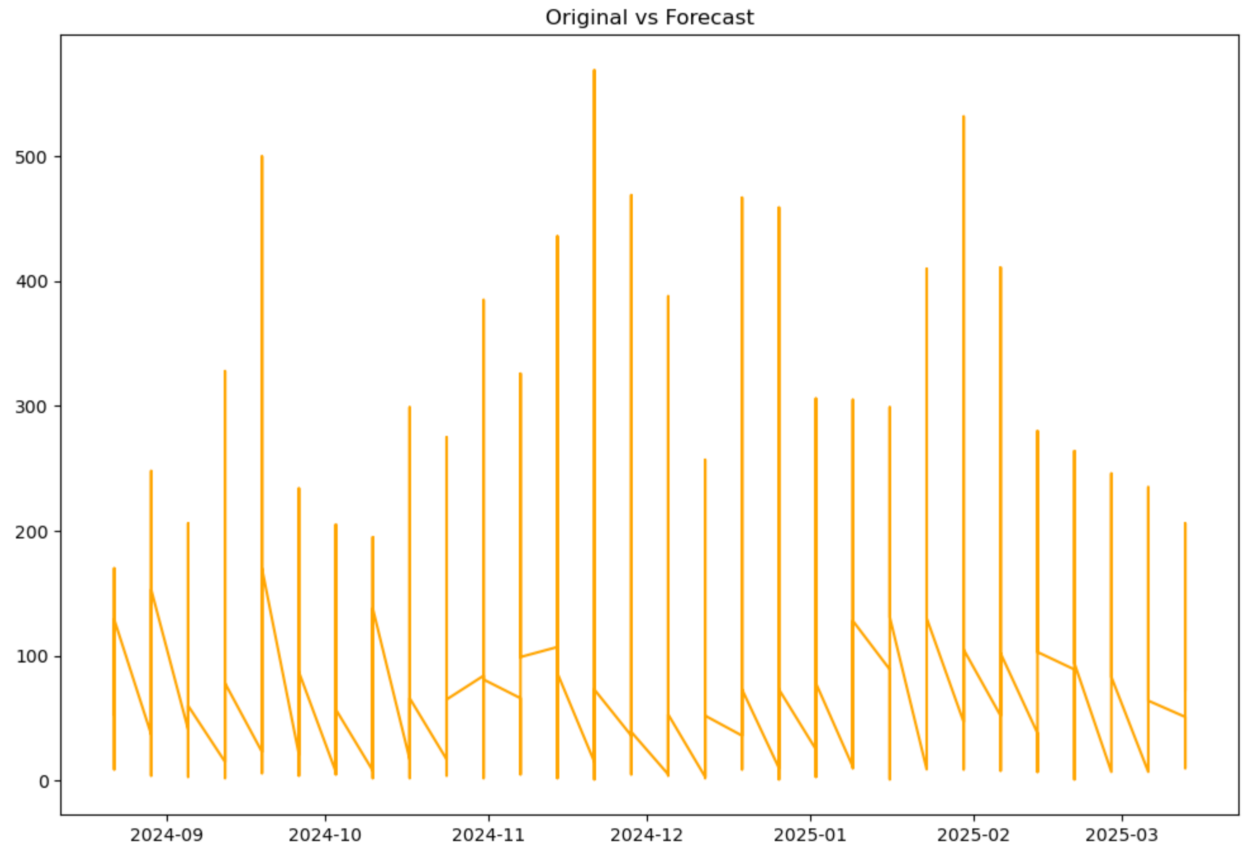
```
test['forecast'] = forecast
test.head()
```

```
C:\Users\DELL\AppData\Local\Temp\ipykernel_8644\2382496083.py:1:
SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation:
https://pandas.pydata.org/pandas-docs/stable/user_guide/indexing.html#
returning-a-view-versus-a-copy
  test['forecast'] = forecast
```

```
                       Country    Status  AQI Value  forecast
Date
2024-08-22             Croatia  Moderate         53       NaN
2024-08-22              Cyprus  Moderate         55       NaN
2024-08-22      Czech Republic      Good         49       NaN
2024-08-22             Denmark      Good         14       NaN
2024-08-22  Dominican Republic      Good         23       NaN
```

```
forecast=mymodel.forecast(steps=len(test))
print(forecast)
```

```
14581    59.775437
14582    60.125750
14583    60.134658
14584    60.134885
14585    60.134891
           ...
18222    60.134891
18223    60.134891
18224    60.134891
18225    60.134891
18226    60.134891
Name: predicted_mean, Length: 3646, dtype: float64

C:\Users\DELL\anaconda3\Lib\site-packages\statsmodels\tsa\base\
tsa_model.py:836: ValueWarning: No supported index is available.
Prediction results will be given with an integer index beginning at
`start`.
  return get_prediction_index(
C:\Users\DELL\anaconda3\Lib\site-packages\statsmodels\tsa\base\
tsa_model.py:836: FutureWarning: No supported index is available. In
the next version, calling this method in a model without a supported
index will result in an exception.
  return get_prediction_index(

test.head()

                          Country    Status  AQI Value  forecast
Date
2024-08-22                Croatia  Moderate         53       NaN
2024-08-22                 Cyprus  Moderate         55       NaN
2024-08-22         Czech Republic      Good         49       NaN
2024-08-22                Denmark      Good         14       NaN
2024-08-22     Dominican Republic      Good         23       NaN

plt.figure(figsize=(12,8))
plt.plot(test.index,test['AQI Value'],color='orange',label="Original")
plt.plot(test.index,test['forecast'],color='green',label="Forecast")
plt.title("Original vs Forecast")
plt.show()
```


Original vs Forecast