```
import numpy as np
```

```
!pip install pmdarima
from pmdarima.arima import auto_arima
```

```
Collecting pmdarima
  Downloading pmdarima-1.8.4-cp37-cp37m-manylinux_2_17_x86_64.manylinux2014_x86_64.manyl
     |████████████████████████████████| 1.4 MB 5.5 MB/s
Requirement already satisfied: pandas>=0.19 in /usr/local/lib/python3.7/dist-packages (f
Requirement already satisfied: scipy>=1.3.2 in /usr/local/lib/python3.7/dist-packages (f
Collecting statsmodels!=0.12.0,>=0.11
  Downloading statsmodels-0.13.1-cp37-cp37m-manylinux_2_17_x86_64.manylinux2014_x86_64.w
     |████████████████████████████████| 9.8 MB 41.5 MB/s
Requirement already satisfied: setuptools!=50.0.0,>=38.6.0 in /usr/local/lib/python3.7/d
Requirement already satisfied: scikit-learn>=0.22 in /usr/local/lib/python3.7/dist-packa
Requirement already satisfied: joblib>=0.11 in /usr/local/lib/python3.7/dist-packages (f
Requirement already satisfied: urllib3 in /usr/local/lib/python3.7/dist-packages (from p
Requirement already satisfied: Cython!=0.29.18,>=0.29 in /usr/local/lib/python3.7/dist-p
Requirement already satisfied: numpy>=1.19.3 in /usr/local/lib/python3.7/dist-packages (
Requirement already satisfied: pytz>=2017.2 in /usr/local/lib/python3.7/dist-packages (f
Requirement already satisfied: python-dateutil>=2.7.3 in /usr/local/lib/python3.7/dist-p
Requirement already satisfied: six>=1.5 in /usr/local/lib/python3.7/dist-packages (from
Requirement already satisfied: threadpoolctl>=2.0.0 in /usr/local/lib/python3.7/dist-pac
Requirement already satisfied: patsy>=0.5.2 in /usr/local/lib/python3.7/dist-packages (f
Installing collected packages: statsmodels, pmdarima
  Attempting uninstall: statsmodels
    Found existing installation: statsmodels 0.10.2
    Uninstalling statsmodels-0.10.2:
      Successfully uninstalled statsmodels-0.10.2
Successfully installed pmdarima-1.8.4 statsmodels-0.13.1
```

```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import warnings
warnings.filterwarnings('ignore')
```

```
df= pd.read_csv('/content/germany-wind-energy.csv')
```

```
df.head()
```

	utc_timestamp	wind_generation_actual	wind_capacity	temperature
0	2017-01-01 00:00:00+00:00	291760.0	37149.130	-2.117
1	2017-01-02 00:00:00+00:00	295097.0	37152.125	-1.154
2	2017-01-03 00:00:00+00:00	666170.0	37155.208	-0.239
4	2017-01-05 00:00:00+00:00	261759.0	37163.542	-3.908

```
df.describe().T
```

	count	mean	std	min	25%	
wind_generation_actual	1094.0	305819.767824	205728.857915	16482.000	148552.75000	254
wind_capacity	1094.0	45066.022789	4315.838061	37149.130	41447.93750	46
temperature	1094.0	10.050167	7.739158	-9.363	3.57725	

```
df['utc_timestamp']=pd.to_datetime(df['utc_timestamp'])
```

```
df.set_index('utc_timestamp',inplace=True)
```

```
df.head()
```

utc_timestamp	wind_generation_actual	wind_capacity	temperature
2017-01-01 00:00:00+00:00	291760.0	37149.130	-2.117
2017-01-02 00:00:00+00:00	295097.0	37152.125	-1.154
2017-01-03 00:00:00+00:00	666170.0	37155.208	-0.239
2017-01-04 00:00:00+00:00	686581.0	37160.125	0.620
2017-01-05 00:00:00+00:00	261759.0	37163.542	-3.908

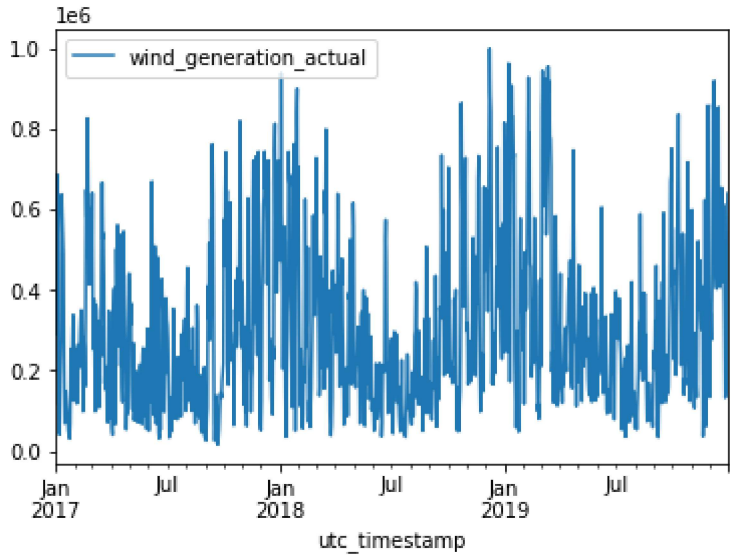
```
drop=df.drop(['wind_capacity','temperature'],axis=1,inplace=True)
```

```
df.head()
```

utc_timestamp	wind_generation_actual
2017-01-01 00:00:00+00:00	291760.0
2017-01-02 00:00:00+00:00	295097.0
2017-01-03 00:00:00+00:00	666170.0
2017-01-04 00:00:00+00:00	686581.0
2017-01-05 00:00:00+00:00	261759.0

```
df.plot()
```

```
<matplotlib.axes._subplots.AxesSubplot at 0x7ff3a7b9e910>
```




```
# Calculate the Missing Values
df.isna().sum()
```

```
wind_generation_actual    0
wind_capacity             0
temperature               0
dtype: int64
```

```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
DatetimeIndex: 1094 entries, 2017-01-01 00:00:00+00:00 to 2019-12-30 00:00:00+00:00
Data columns (total 3 columns):
 #   Column                  Non-Null Count  Dtype  
---  ------                  --------------  -----  
 0   wind_generation_actual  1094 non-null   float64
 1   wind_capacity           1094 non-null   float64
 2   temperature             1094 non-null   float64
dtypes: float64(3)
memory usage: 34.2 KB
```

```
#stationarity test
from pmdarima.arima import ADFTest
adf_test = ADFTest(alpha = 0.05)
adf_test.should_diff(df)
```

```
(0.01, False)
```

```
#Spliting the dataset into train and test
train = df[:85]
test = df[-20:]
```

```
train.tail()
```

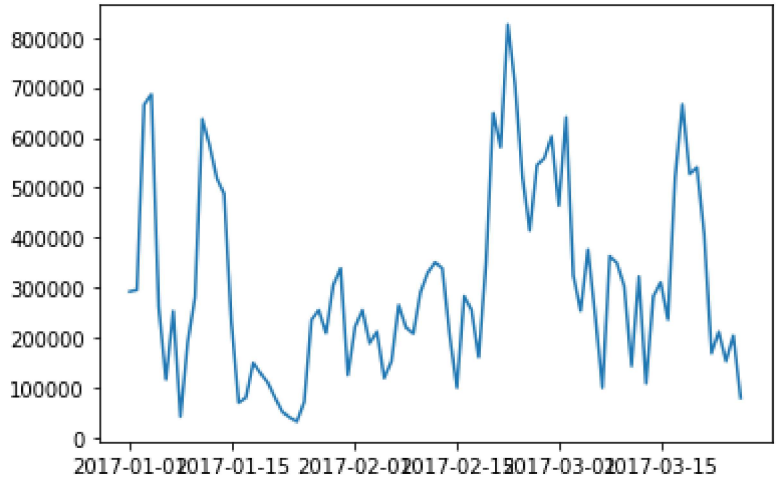
utc_timestamp	wind_generation_actual
2017-03-22 00:00:00+00:00	168379.0
2017-03-23 00:00:00+00:00	211125.0
2017-03-24 00:00:00+00:00	152372.0
2017-03-25 00:00:00+00:00	203031.0
2017-03-26 00:00:00+00:00	79142.0

```
test.head()
```

utc_timestamp	wind_generation_actual
2019-12-11 00:00:00+00:00	436289.0
2019-12-12 00:00:00+00:00	403284.0
2019-12-13 00:00:00+00:00	555000.0
2019-12-14 00:00:00+00:00	843230.0
2019-12-15 00:00:00+00:00	853649.0

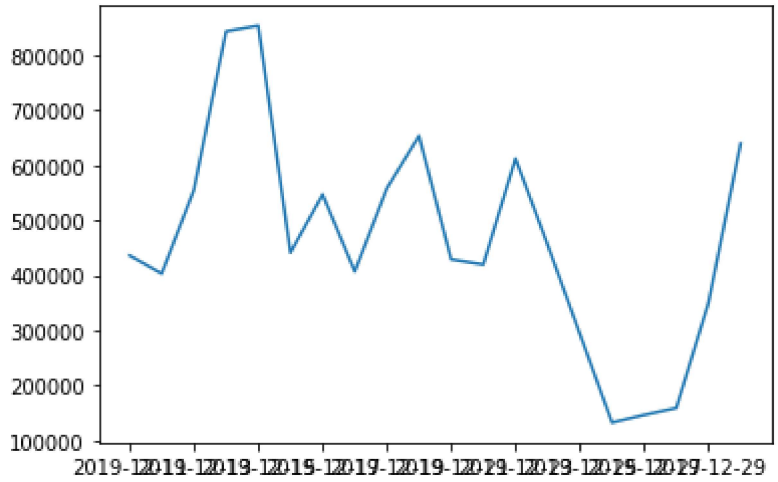
```
plt.plot(train)
```

```
[<matplotlib.lines.Line2D at 0x7ff3a3243d50>]
```




```
plt.plot(test)
```

```
[<matplotlib.lines.Line2D at 0x7ff39a95a590>]
```




```
plt.figure(figsize=(15,5))
plt.plot(test)
```

```
[<matplotlib.lines.Line2D at 0x7ff39a935110>]
```

```
arima_model =  auto_arima(train,start_p=0, d=1, start_q=0,
                          max_p=5, max_d=5, max_q=5, start_P=0,
                          D=1, start_Q=0, max_P=5, max_D=5,
                          max_Q=5, m=12, seasonal=True,
                          error_action='warn',trace = True,
                          supress_warnings=True,stepwise = True,
                          random_state=20,n_fits = 50 )


Performing stepwise search to minimize aic
 ARIMA(0,1,0)(0,1,0)[12]             : AIC=1971.530, Time=0.06 sec
 ARIMA(1,1,0)(1,1,0)[12]             : AIC=1946.219, Time=0.23 sec
 ARIMA(0,1,1)(0,1,1)[12]             : AIC=1938.445, Time=0.22 sec
 ARIMA(0,1,1)(0,1,0)[12]             : AIC=1973.464, Time=0.04 sec
 ARIMA(0,1,1)(1,1,1)[12]             : AIC=1938.722, Time=0.39 sec
 ARIMA(0,1,1)(0,1,2)[12]             : AIC=1938.864, Time=0.63 sec
 ARIMA(0,1,1)(1,1,0)[12]             : AIC=1941.371, Time=0.20 sec
 ARIMA(0,1,1)(1,1,2)[12]             : AIC=1940.523, Time=1.11 sec
 ARIMA(0,1,0)(0,1,1)[12]             : AIC=1944.153, Time=0.12 sec
 ARIMA(1,1,1)(0,1,1)[12]             : AIC=1938.340, Time=0.72 sec
 ARIMA(1,1,1)(0,1,0)[12]             : AIC=inf, Time=0.57 sec
 ARIMA(1,1,1)(1,1,1)[12]             : AIC=1939.124, Time=1.28 sec
 ARIMA(1,1,1)(0,1,2)[12]             : AIC=1939.135, Time=2.77 sec
 ARIMA(1,1,1)(1,1,0)[12]             : AIC=1942.096, Time=0.88 sec
 ARIMA(1,1,1)(1,1,2)[12]             : AIC=1941.074, Time=1.33 sec
 ARIMA(1,1,0)(0,1,1)[12]             : AIC=1944.119, Time=0.11 sec
 ARIMA(2,1,1)(0,1,1)[12]             : AIC=1940.998, Time=0.35 sec
 ARIMA(1,1,2)(0,1,1)[12]             : AIC=1938.740, Time=0.39 sec
 ARIMA(0,1,2)(0,1,1)[12]             : AIC=1939.016, Time=0.16 sec
 ARIMA(2,1,0)(0,1,1)[12]             : AIC=1940.041, Time=0.17 sec
 ARIMA(2,1,2)(0,1,1)[12]             : AIC=1940.495, Time=0.88 sec
 ARIMA(1,1,1)(0,1,1)[12] intercept   : AIC=inf, Time=0.82 sec

Best model:  ARIMA(1,1,1)(0,1,1)[12]
Total fit time: 13.477 seconds
```

```
arima_model.summary()
```

SARIMAX Results

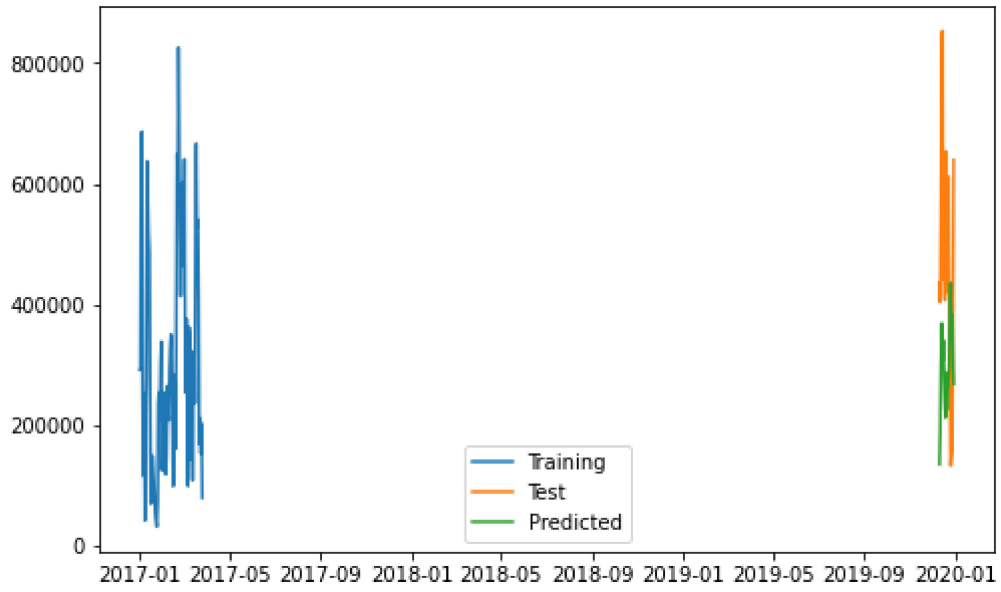
Dep. Variable:	y	**No. Observations:**	85
Model:	SARIMAX(1, 1, 1)x(0, 1, 1, 12)	**Log Likelihood**	-965.170
Date:	Mon, 24 Jan 2022	**AIC**	1938.340
Time:	20:36:21	**BIC**	1947.447
Sample:	0	**HQIC**	1941.966
	- 85		
Covariance Type:	opg		

	coef	std err	z	P>|z|	[0.025	0.975]
ar.L1	0.7588	0.253	2.995	0.003	0.262	1.255
ma.L1	-0.9440	0.232	-4.075	0.000	-1.398	-0.490
ma.S.L12	-0.7344	0.237	-3.098	0.002	-1.199	-0.270

```
prediction = pd.DataFrame(arima_model.predict(n_periods = 20),index=test.index)
prediction.columns = ['predicted_Wind Energy']
prediction
```

utc_timestamp	predicted_Wind Energy
2019-12-11 00:00:00+00:00	134788.775926

```
plt.figure(figsize=(8,5))
plt.plot(train,label="Training")
plt.plot(test,label="Test")
plt.plot(prediction,label="Predicted")
plt.legend(loc = 'Left corner')
plt.show()
```



2019-12-27 00:00:00+00:00	360080.410089
2019-12-29 00:00:00+00:00	324950.510196
2019-12-30 00:00:00+00:00	268162.638706