Time Series

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

loading and viewing data

```
temp_df = pd.read_csv("C:\my files\DailyDelhiClimateTrain.csv")

temp_df.head()
```

	date	meantemp	humidity	wind_speed	meanpressure
0	2013-01-01	10.000000	84.500000	0.000000	1015.666667
1	2013-01-02	7.400000	92.000000	2.980000	1017.800000
2	2013-01-03	7.166667	87.000000	4.633333	1018.666667
3	2013-01-04	8.666667	71.333333	1.233333	1017.166667
4	2013-01-05	6.000000	86.833333	3.700000	1016.500000

```
temp_df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 1462 entries, 0 to 1461
Data columns (total 5 columns):
 #   Column        Non-Null Count  Dtype  
---  ------        --------------  -----  
 0   date          1462 non-null   object 
 1   meantemp      1462 non-null   float64
 2   humidity      1462 non-null   float64
 3   wind_speed    1462 non-null   float64
 4   meanpressure  1462 non-null   float64
dtypes: float64(4), object(1)
memory usage: 57.2+ KB
```

setting date as index

```
#checking for nulls in date column
print(temp_df[temp_df["date"].isna()])
```

```
Empty DataFrame
Columns: [date, meantemp, humidity, wind_speed, meanpressure]
Index: []
```

```
#convert object into date datatype
temp_df["date"] = pd.to_datetime(temp_df["date"],errors="coerce")
temp_df.info()
```

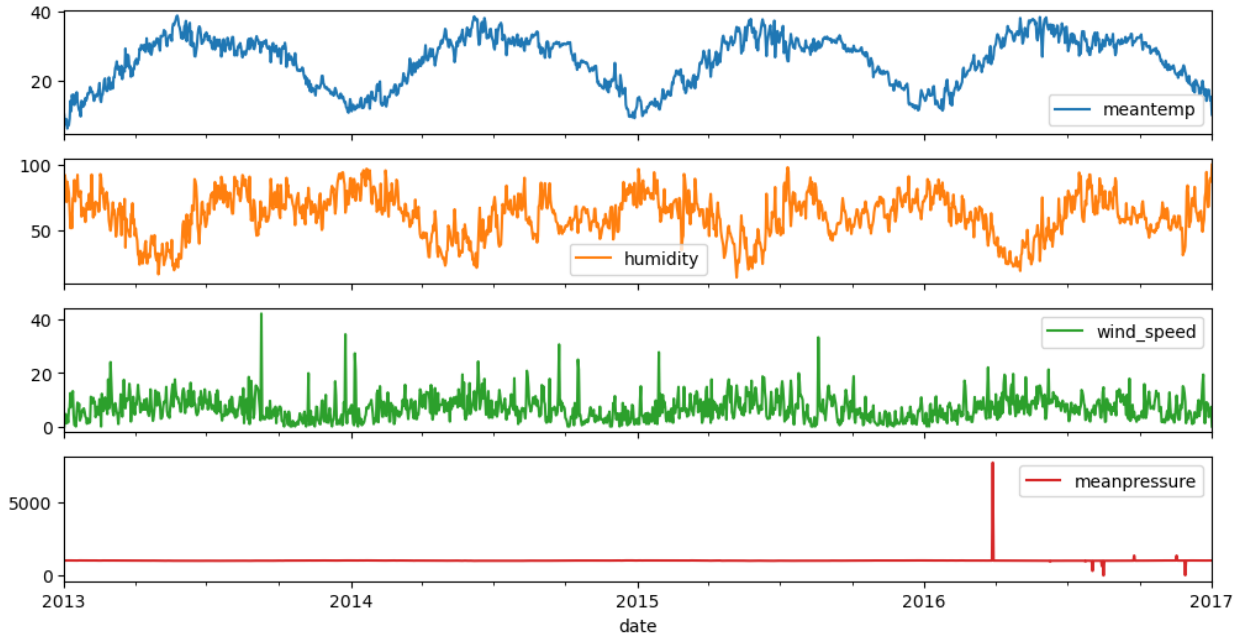
```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 1462 entries, 0 to 1461
Data columns (total 5 columns):
 #   Column        Non-Null Count  Dtype         
---  ------        --------------  -----         
 0   date          1462 non-null   datetime64[ns]
 1   meantemp      1462 non-null   float64       
 2   humidity      1462 non-null   float64       
 3   wind_speed    1462 non-null   float64       
 4   meanpressure  1462 non-null   float64       
dtypes: datetime64[ns](1), float64(4)
memory usage: 57.2 KB
```

```
#setting index
temp_df.set_index("date",inplace = True)
temp_df.head()
```

date	meantemp	humidity	wind_speed	meanpressure
2013-01-01	10.000000	84.500000	0.000000	1015.666667
2013-01-02	7.400000	92.000000	2.980000	1017.800000
2013-01-03	7.166667	87.000000	4.633333	1018.666667
2013-01-04	8.666667	71.333333	1.233333	1017.166667
2013-01-05	6.000000	86.833333	3.700000	1016.500000

visualise

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



conclusion: 1) meantemp - every year it goes on increases and decreases - when ever the humidity is high the meantemp decreses 2) humidity - humidity varies slighty 3) wind_speed - it is high btw 2013 and 2014 - it is normal in 2016 to 2017 4) meanpressure - it maintance same range up to 2016 from 2013 - it is high in 2016 to 2017

stationarity

A time series is stationary if its statistical properties(men,variance,autocorrelation)remain constant over time

```
hypotheses of the ADF Test
- Null Hypothesis:The time series has a unit root (non - stationary)
- Alternative Hypothesis:The time serie does not have a unit
root(stationary)

adfuller_result = adfuller(temp_df["meantemp"])
print(adfuller_result)

(-2.0210690559206728, 0.27741213723016056, 10, 1451, {'1%': -
3.4348647527922824, '5%': -2.863533960720434, '10%': -
2.567831568508802}, 5423.895746470953)

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

Non - Stationary
```

Differencing to Remove Trend

- Differencing is a technique used to make a non-stationary time series stationary by remving trends or seasonality.it involves subtracting the preious observation from the current observation
- temp =[20,21,22,24,25,27,28,27]
- diff =[1,1,2,1,2,1,-1]
- the new series fluctuates around zero -2 to 2

```
temp_df['meantemp_diff'] = temp_df["meantemp"].diff()
temp_df.head()
```

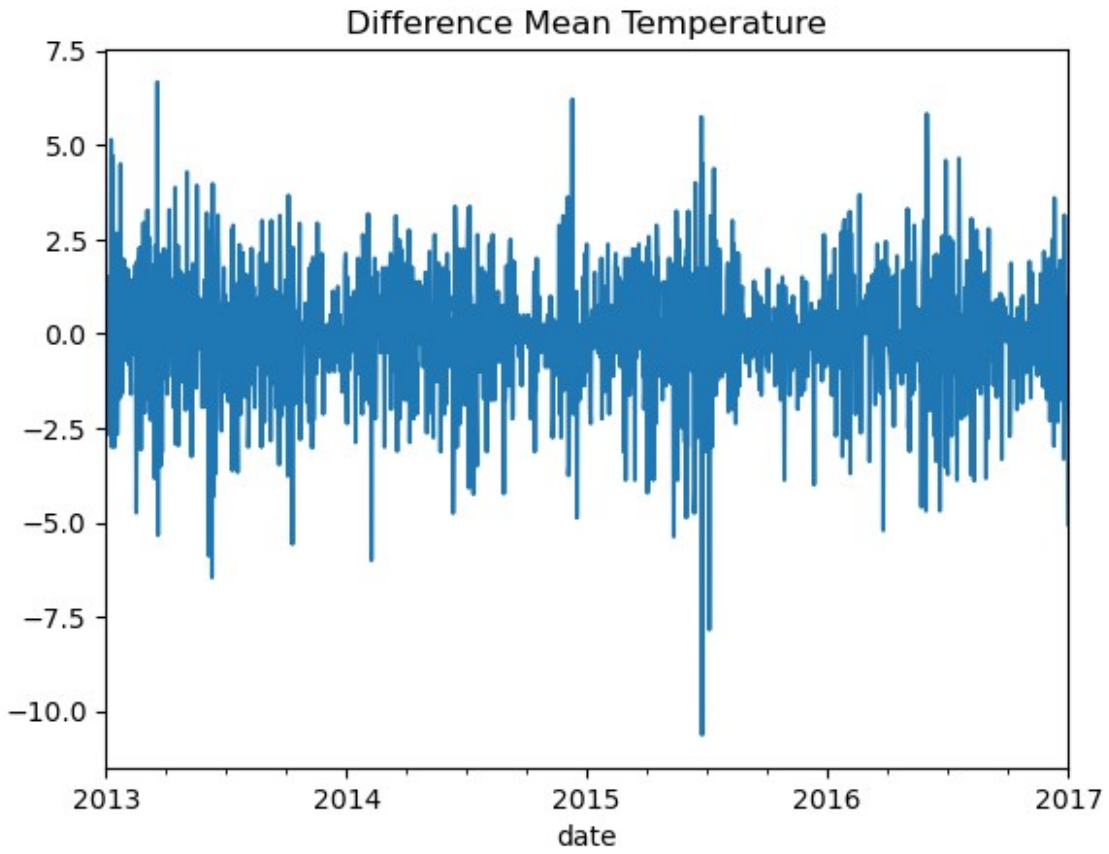
```
             meantemp   humidity  wind_speed  meanpressure
meantemp_diff
date

2013-01-01  10.000000  84.500000    0.000000   1015.666667
NaN
2013-01-02   7.400000  92.000000    2.980000   1017.800000      -
2.600000
2013-01-03   7.166667  87.000000    4.633333   1018.666667      -
0.233333
2013-01-04   8.666667  71.333333    1.233333   1017.166667
1.500000
2013-01-05   6.000000  86.833333    3.700000   1016.500000      -
2.666667
```

```
adfuller_resul_afterdiff = adfuller(temp_df["meantemp_diff"].dropna())
if adfuller_result[1]>0.05:
    print("Stationary")
else:
    print("Non - Stationary")
```

```
Stationary
```

```
temp_df["meantemp_diff"].plot(title = "Difference Mean Temperature")
plt.show()
```



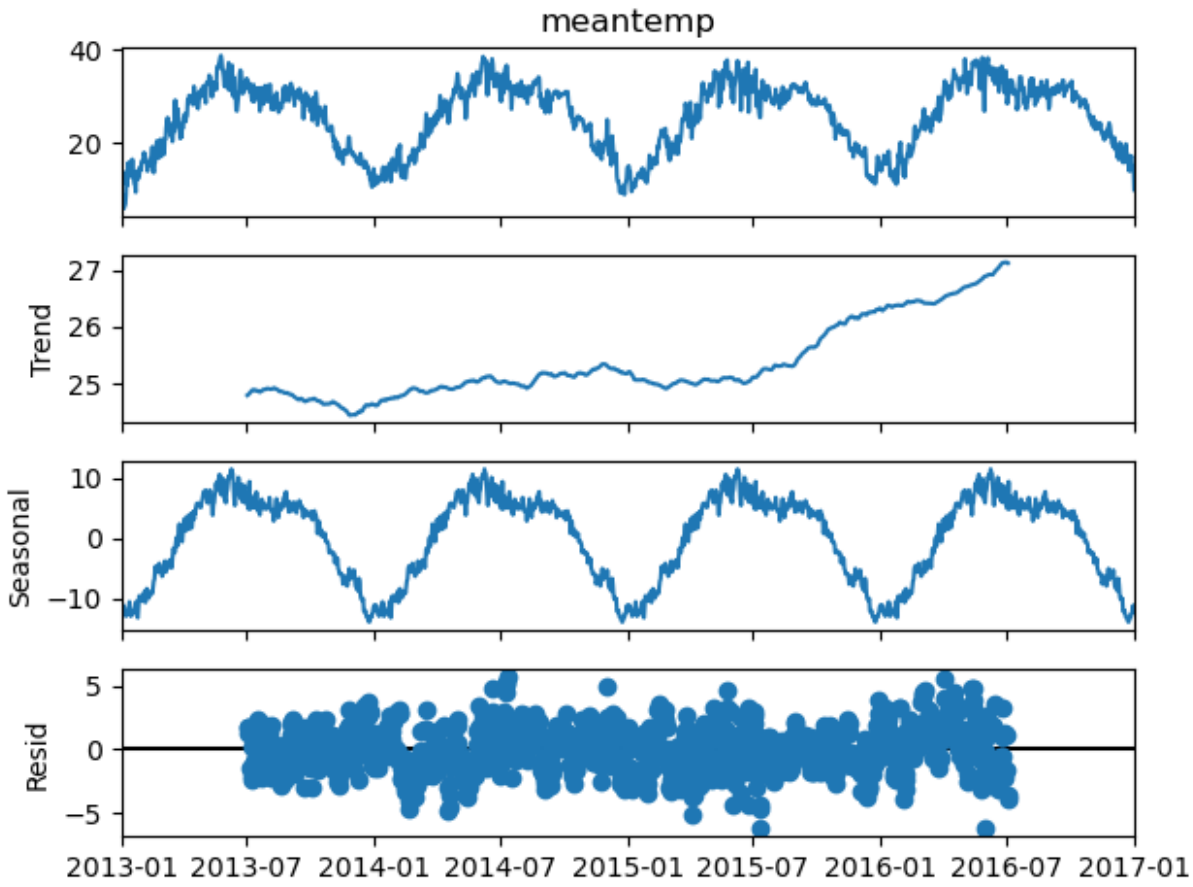
concusion: 1) The data shows variation in temperature between -10 and 7.5 with a mean of 0 2) there is no long difference in trends but frequent peaks shows low spikes in 2015-2016. 3) there is outliers 4) the mean temperature is now stationary

use seasonal decomposition to analyze trend,seasonality,and residuals

- Trend : The long term pattern(increase or decrease over time)
- seasonality : The repeating patterns at fixed intervals(monthly sales spikes)
- Residual(Noise) : The random variations that are not explaines by trend or seasonality
- interpreting the Output:
- original series : The raw time series data
- trend component : The general direction of the data over time
- seasonal component : The repeating patterns(eg:higher sales in december)
- Residual component : The remaining part after removing trend and seasonally

```
decomposing = seasonal_decompose(temp_df["meantemp"],model =
"additive",period = 365)
```

```
decomposing.plot()
plt.show()
```



conculsion: 1) there is a rapid increase in trend between 7/2015 to 7/2016 2) it exhibits a clear seasonal pattern,with same fluctuations repeating over time 3) the residuals is randomly distributed

ARIMA

```
# splitting data
len(temp_df)
```

```
1462
```

```
print(len(temp_df)*0.8)
```

```
1169.6000000000001
```

```
train = temp_df.iloc[0:1169]
test = temp_df.iloc[1169:]
len(test)
```

```
293
```

```
mymodel = ARIMA(train["meantemp"],order=(1,1,1))
```

```
C:\ProgramData\anaconda3\Lib\site-packages\statsmodels\tsa\base\
tsa_model.py:473: ValueWarning: No frequency information was provided,
so inferred frequency D will be used.
  self._init_dates(dates, freq)
C:\ProgramData\anaconda3\Lib\site-packages\statsmodels\tsa\base\
tsa_model.py:473: ValueWarning: No frequency information was provided,
so inferred frequency D will be used.
  self._init_dates(dates, freq)
C:\ProgramData\anaconda3\Lib\site-packages\statsmodels\tsa\base\
tsa_model.py:473: ValueWarning: No frequency information was provided,
so inferred frequency D will be used.
  self._init_dates(dates, freq)
```

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

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

```
2016-03-15    22.826205
2016-03-16    23.085687
2016-03-17    23.234913
2016-03-18    23.320731
2016-03-19    23.370084
Freq: D, Name: predicted_mean, dtype: float64
```

```
test["forecaste"] = forecast
test.head()
```

```
C:\Users\DELL\AppData\Local\Temp\ipykernel_9892\3744547450.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["forecaste"] = forecast
```

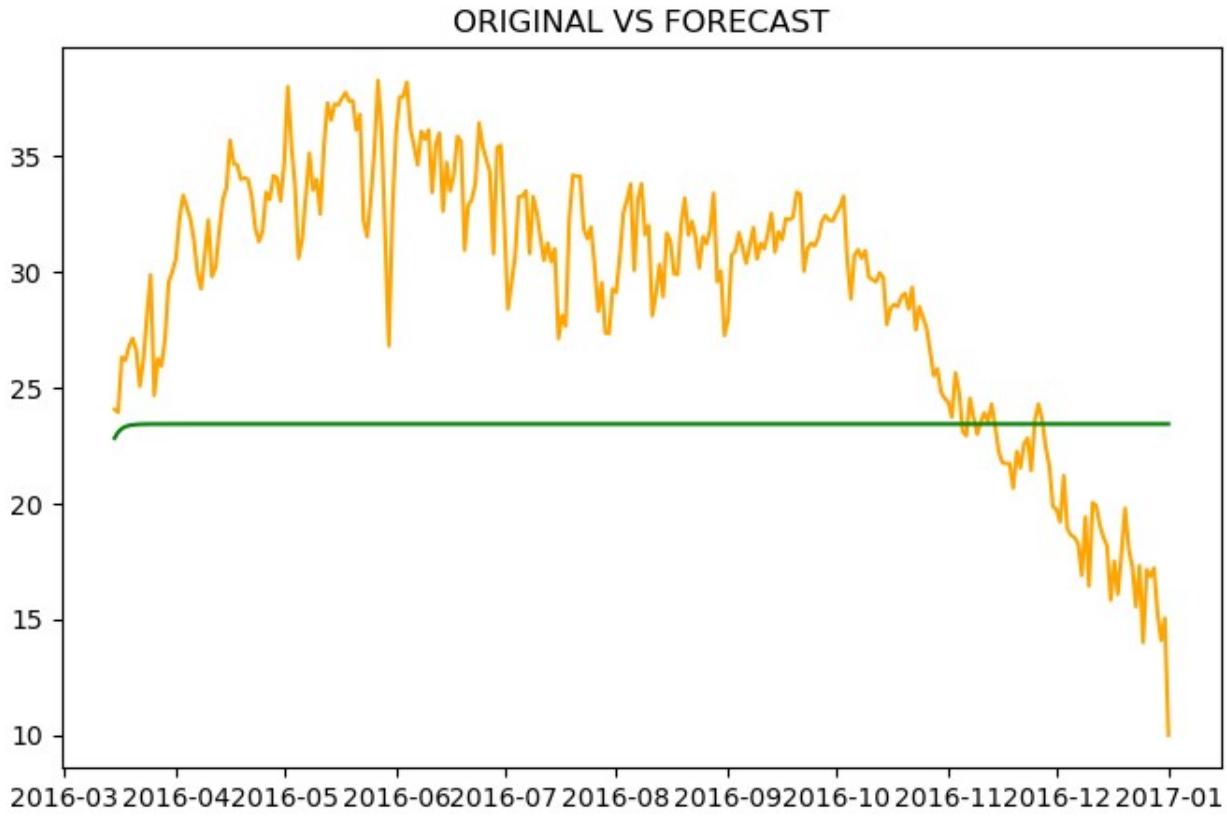
```
             meantemp   humidity  wind_speed  meanpressure
meantemp_diff  \
date

2016-03-15  24.066667  58.933333    8.646667   1014.866667
1.691667
2016-03-16  23.937500  53.750000   10.881250   1012.812500      -
0.129167
2016-03-17  26.312500  50.312500    6.843750   1010.437500
```

```
2.375000
2016-03-18  26.187500  61.250000    6.712500   1009.812500      -
0.125000
2016-03-19  26.785714  61.857143    3.578571   1009.214286
0.598214

             forecaste
date
2016-03-15  22.826205
2016-03-16  23.085687
2016-03-17  23.234913
2016-03-18  23.320731
2016-03-19  23.370084
```

```
plt.figure(figsize=(8,5))
plt.plot(test.index,test["meantemp"],color="orange",label="Original")
plt.plot(test.index,test["forecaste"],color="green",label="Forecast")
plt.title("ORIGINAL VS FORECAST")
plt.show()
```




```
len(temp_df)
```

```
1462
```

```
print(len(temp_df)*0.8)
```

```
1169.6000000000001
```

```
train1 = temp_df.iloc[0:1169]
test1 = temp_df.iloc[1169:]
len(test1)
```

```
293
```

```
mymodel = ARIMA(train["meantemp_diff"],order=(1,1,1))
```

```
C:\ProgramData\anaconda3\Lib\site-packages\statsmodels\tsa\base\
tsa_model.py:473: ValueWarning: No frequency information was provided,
so inferred frequency D will be used.
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C:\ProgramData\anaconda3\Lib\site-packages\statsmodels\tsa\base\
tsa_model.py:473: ValueWarning: No frequency information was provided,
so inferred frequency D will be used.
  self._init_dates(dates, freq)
```

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

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

```
2016-03-15    0.322914
2016-03-16   -0.040400
2016-03-17    0.019656
2016-03-18    0.009729
2016-03-19    0.011370
Freq: D, Name: predicted_mean, dtype: float64
```

```
test1["forecaste_diff"] = forecast
test1.head()
```

```
C:\Users\DELL\AppData\Local\Temp\ipykernel_9892\990163927.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
  test1["forecaste_diff"] = forecast
```

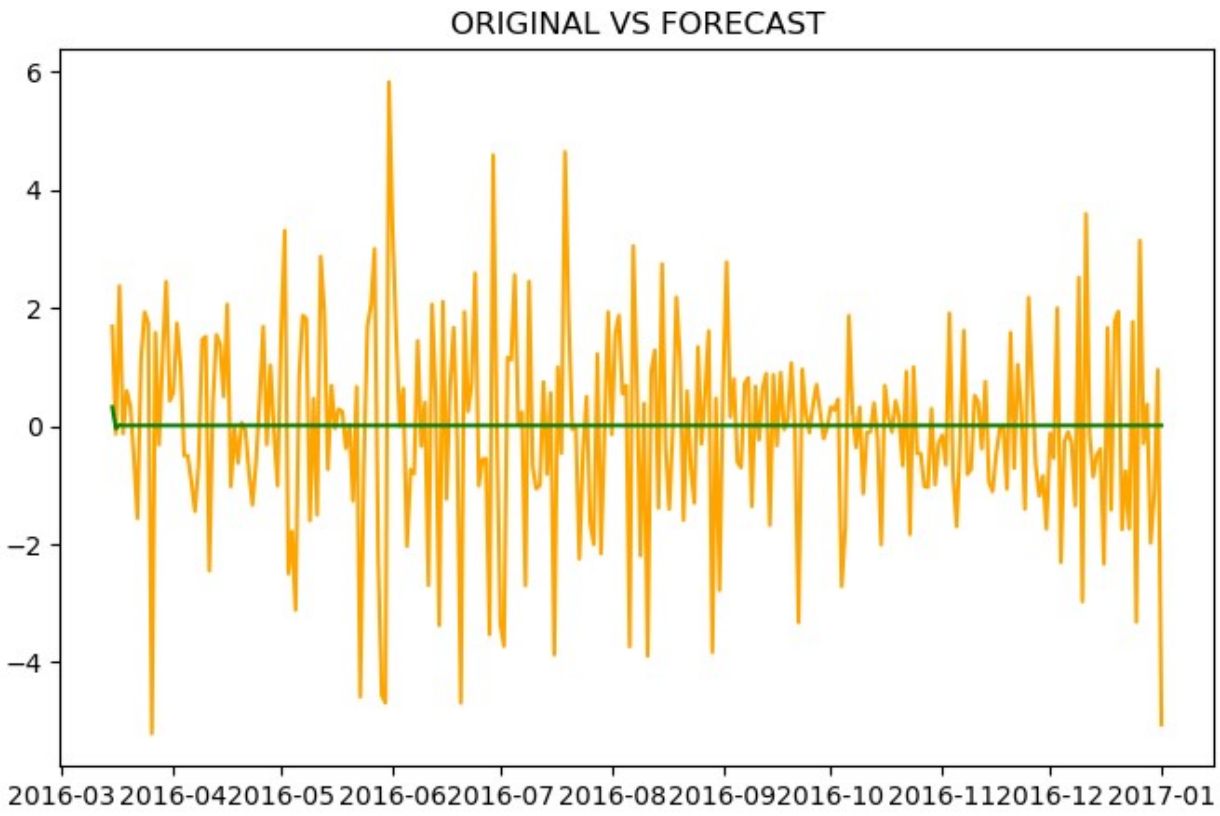
```
             meantemp   humidity  wind_speed  meanpressure
meantemp_diff  \
```

```
date

2016-03-15  24.066667  58.933333    8.646667   1014.866667
1.691667
2016-03-16  23.937500  53.750000   10.881250   1012.812500      -
0.129167
2016-03-17  26.312500  50.312500    6.843750   1010.437500
2.375000
2016-03-18  26.187500  61.250000    6.712500   1009.812500      -
0.125000
2016-03-19  26.785714  61.857143    3.578571   1009.214286
0.598214

             forecaste_diff
date
2016-03-15        0.322914
2016-03-16       -0.040400
2016-03-17        0.019656
2016-03-18        0.009729
2016-03-19        0.011370
```

```
plt.figure(figsize=(8,5))
plt.plot(test.index,test["meantemp_diff"],color="orange",label="Origin
al")
plt.plot(test.index,test["forecaste_diff"],color="green",label="Foreca
st")
plt.title("ORIGINAL VS FORECAST")
plt.show()
```



conculsion: 1) 15th mar,original value = 24.066667 , model says there is -0.040400 change on next day 24.066667-0.040400 = 24.10(predict) and 23.937(original)