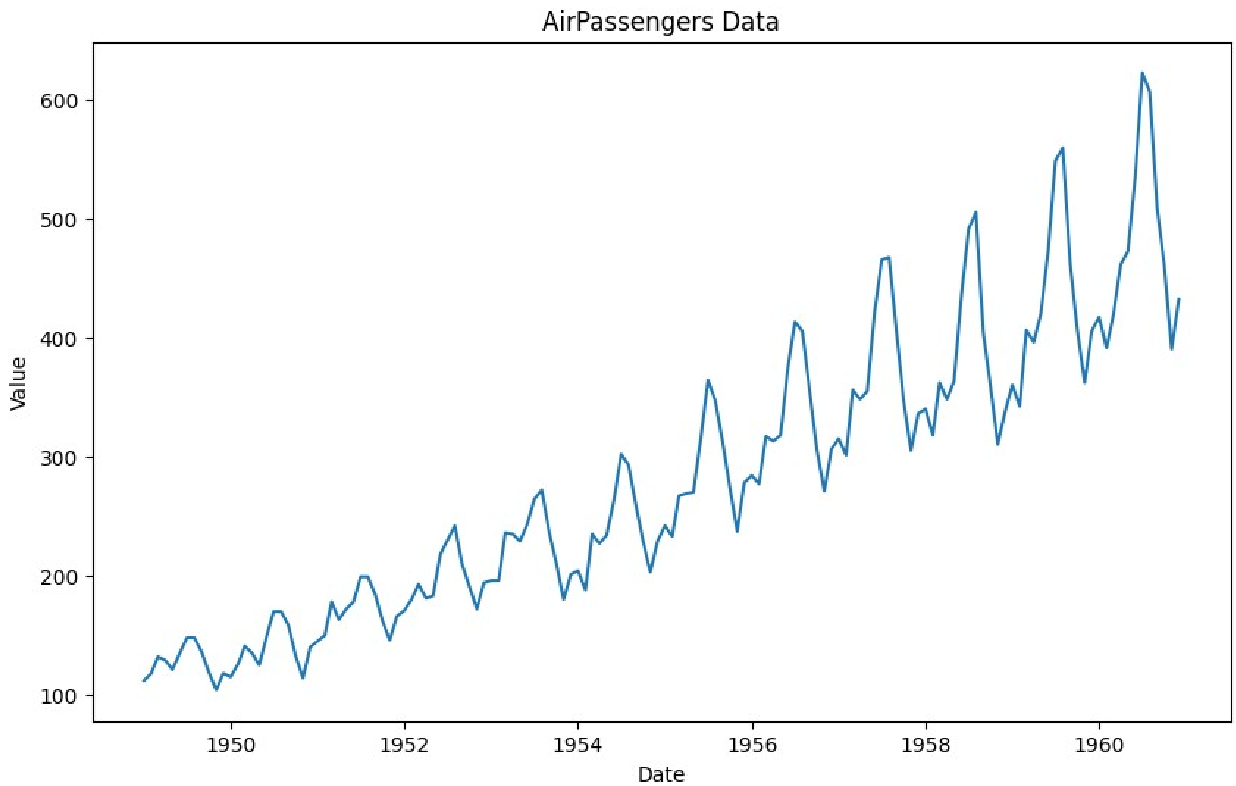
AirPassengers

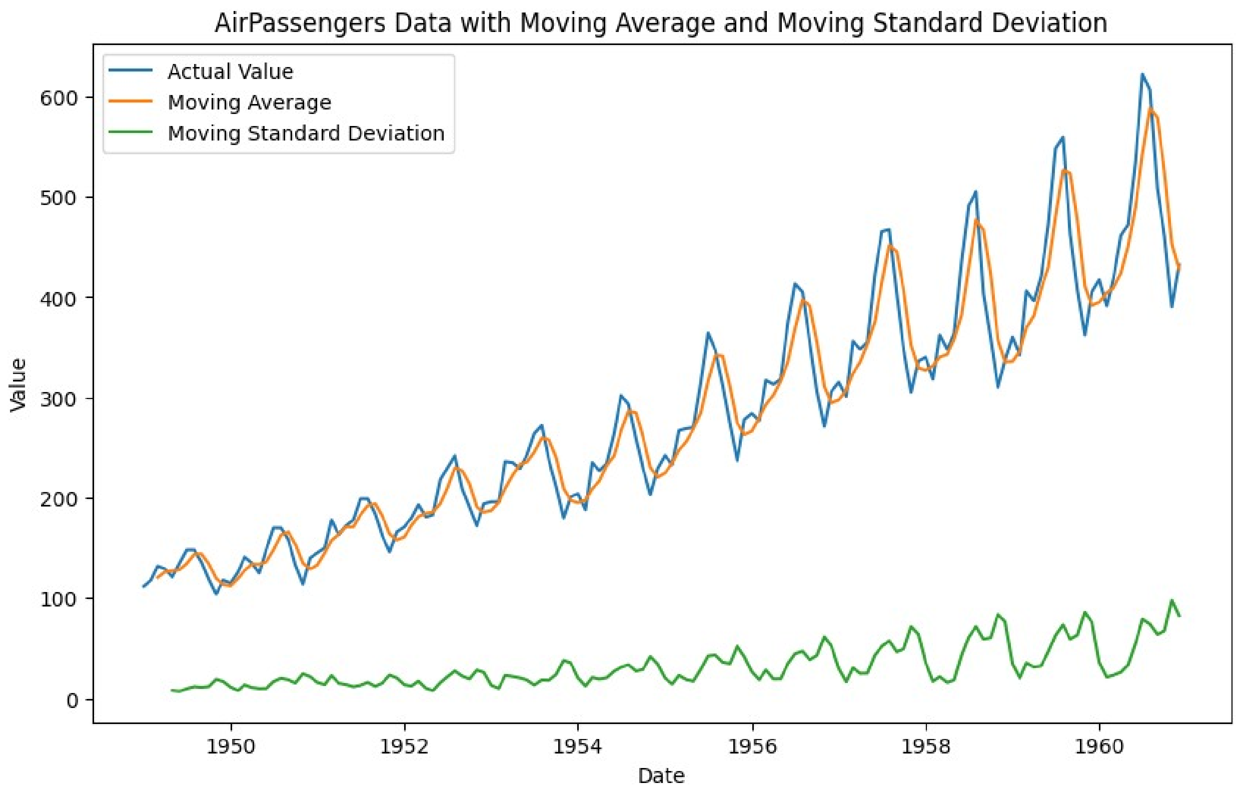
```
import pandas as pd

data = pd.read_csv("AirPassengers.csv")

data

           date  value
0    1949-01-01    112
1    1949-02-01    118
2    1949-03-01    132
3    1949-04-01    129
4    1949-05-01    121
..          ...    ...
139  1960-08-01    606
140  1960-09-01    508
141  1960-10-01    461
142  1960-11-01    390
143  1960-12-01    432

[144 rows x 2 columns]

data.info()

<class 'pandas.core.frame.DataFrame'>
RangeIndex: 144 entries, 0 to 143
Data columns (total 2 columns):
 #   Column  Non-Null Count  Dtype
---  ------  --------------  -----
 0   date    144 non-null    object
 1   value   144 non-null    int64
dtypes: int64(1), object(1)
memory usage: 2.4+ KB

data.dtypes

date     object
value     int64
dtype: object

data.isnull().sum()

date     0
value    0
dtype: int64



import matplotlib.pyplot as plt
```

```
# Convert the 'date' column to datetime format
data['date'] = pd.to_datetime(data['date'])

# Plot the line plot
plt.figure(figsize=(10, 6))
plt.plot(data['date'], data['value'])
plt.xlabel('Date')
plt.ylabel('Value')
plt.title('AirPassengers Data')
plt.show()
```

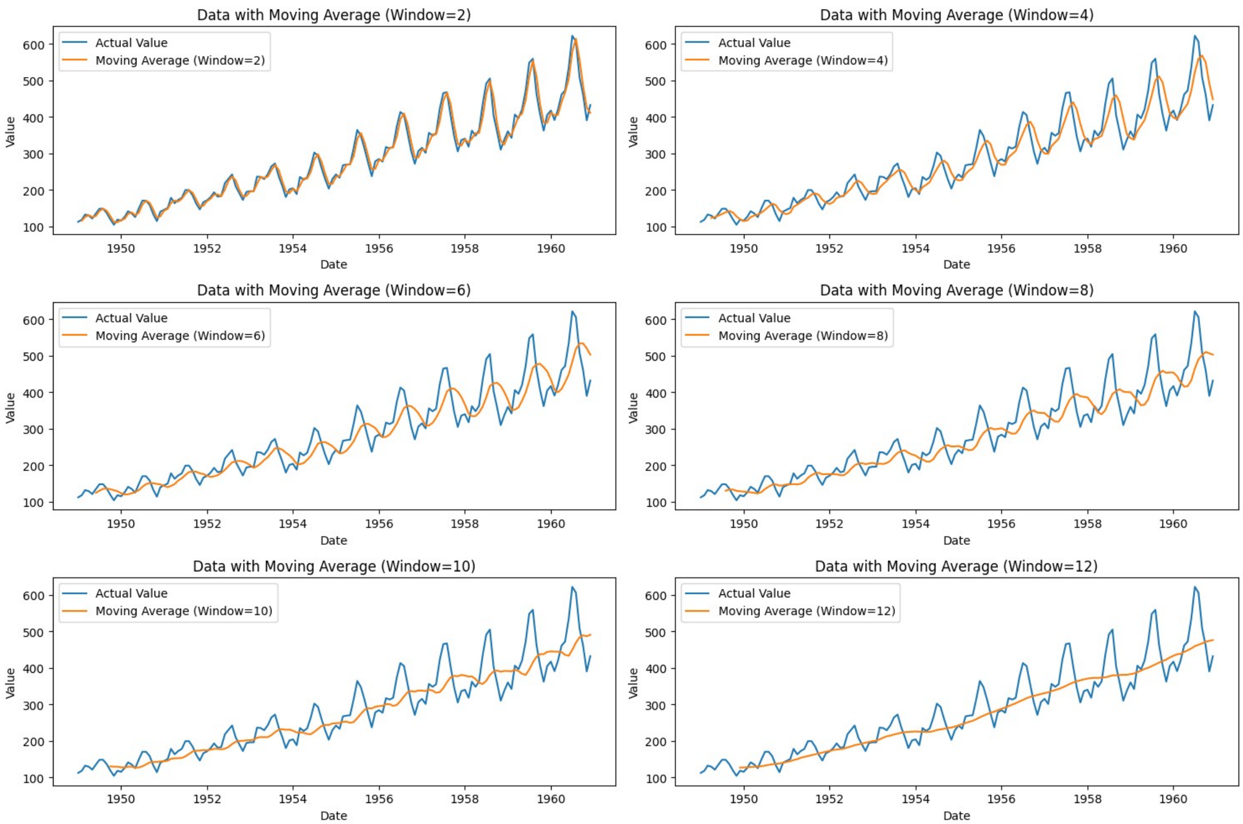



```
data = data.set_index('date',inplace = False)


# Calculate the simple average using rolling command
movingAverage = data.rolling(window=3).mean()
# Calculate the moving standard deviation using rolling command
movingSTD = data.rolling(window=5).std()

# Plot the actual value, moving average, and moving standard deviation
plt.figure(figsize=(10, 6))
plt.plot(data.index, data['value'], label='Actual Value')
plt.plot(movingAverage.index, movingAverage['value'], label='Moving
Average')
plt.plot(movingSTD.index, movingSTD['value'], label='Moving Standard
```

```
Deviation')
plt.xlabel('Date')
plt.ylabel('Value')
plt.title('AirPassengers Data with Moving Average and Moving Standard
Deviation')
plt.legend()
plt.show()
```




```
plt.figure(figsize=(15, 10))

# Plot 6 subplots with different window values
for i, window in enumerate([2, 4, 6, 8, 10, 12]):
    movingAverage = data.rolling(window=window).mean()
    plt.subplot(3, 2, i+1)
    plt.plot(data.index, data['value'], label='Actual Value')
    plt.plot(movingAverage.index, movingAverage['value'],
label=f'Moving Average (Window={window})')
    plt.xlabel('Date')
    plt.ylabel('Value')
    plt.title(f'Data with Moving Average (Window={window})')
    plt.legend()

plt.tight_layout()
plt.show()
```




```
#if there is a large diff in moving avg when window size is small or
low that date we should analyse more

from statsmodels.tsa.stattools import adfuller

# assuming null hypothisis as the series is non stationary
# and alternative hypothesis as series is stationary
# if test statistics is < critical value and p-value < 0.05 we reject
the null hypothesis

#ADF Test
def adf_test(timeseries):

 print('results of dickey_fuller test:')

 dftest=adfuller(timeseries,autolag='AIC')

 dfoutput=pd.Series(dftest[0:4],index=['Test Statistics','p-
value','#lags used','Number of observations used'])

 for key,value in dftest[4].items():

  dfoutput['critical value(%s)'%key]=value

  print(dfoutput)
```

```python
adf_test(data['value'])
```

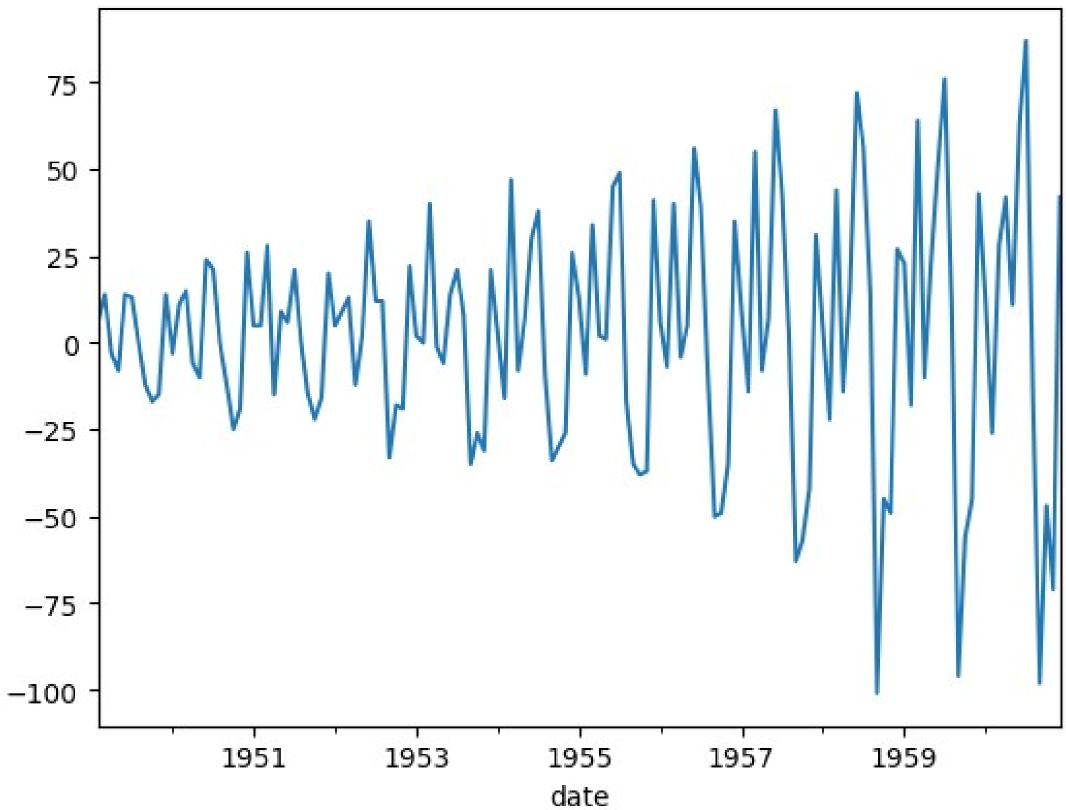
```
results of dickey_fuller test:
Test Statistics                   0.815369
p-value                           0.991880
#lags used                       13.000000
Number of observations used     130.000000
critical value(1%)               -3.481682
dtype: float64
Test Statistics                   0.815369
p-value                           0.991880
#lags used                       13.000000
Number of observations used     130.000000
critical value(1%)               -3.481682
critical value(5%)               -2.884042
dtype: float64
Test Statistics                   0.815369
p-value                           0.991880
#lags used                       13.000000
Number of observations used     130.000000
critical value(1%)               -3.481682
critical value(5%)               -2.884042
critical value(10%)              -2.578770
dtype: float64
```

```python
# dataset is not stationary
# as the p value and test stastistics is < 0.05



# KPSS Test
#here :
#     assuming that the null hypothesis as series is stationary
#     alternative hypothesis is series is non stationary

from statsmodels.tsa.stattools import kpss


def kpss_test(timeseries):
    print('Results of KPSS Test:')
    kpsstest = kpss(timeseries, regression='c')
    kpss_output = pd.Series(kpsstest[0:3], index=['Test Statistics',
'p-value', 'Lags Used'])
    for key, value in kpsstest[3].items():
        kpss_output['Critical Value (%s)' % key] = value
    print(kpss_output)

kpss_test(data['value'])
```

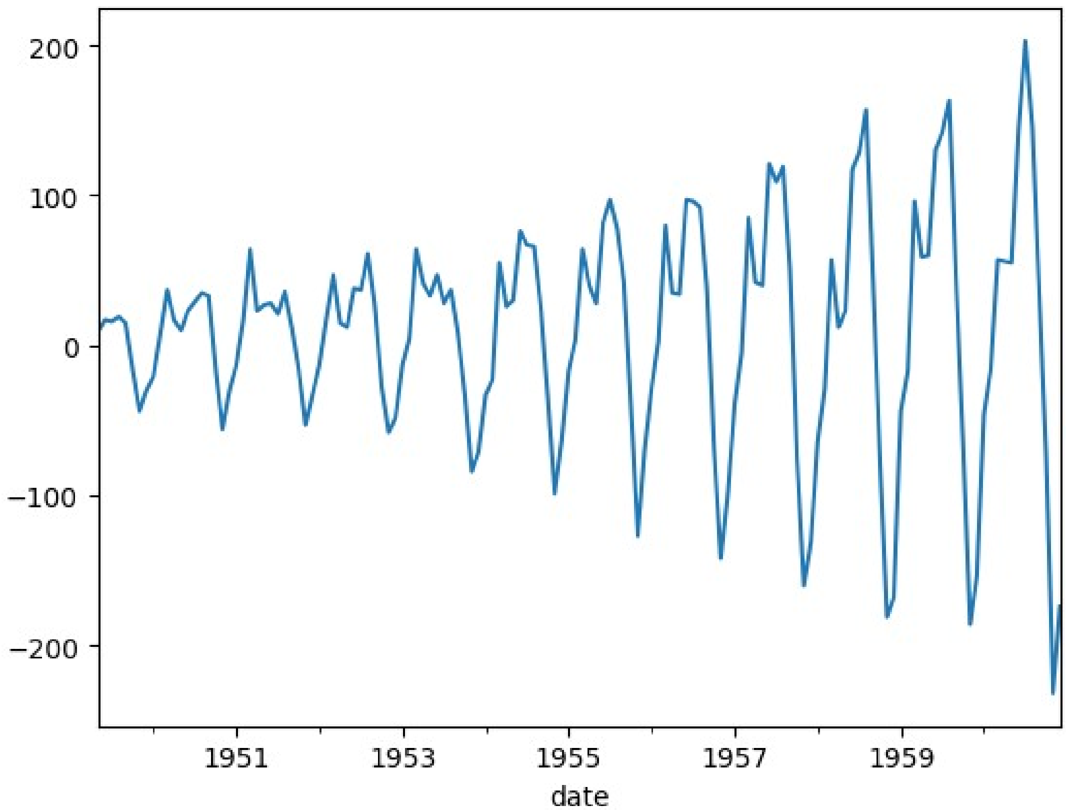
```
Results of KPSS Test:
Test Statistics            1.651312
p-value                    0.010000
Lags Used                  8.000000
Critical Value (10%)       0.347000
Critical Value (5%)        0.463000
Critical Value (2.5%)      0.574000
Critical Value (1%)        0.739000
dtype: float64

C:\Users\aRj\AppData\Local\Temp\ipykernel_12744\2159506141.py:3:
InterpolationWarning: The test statistic is outside of the range of p-
values available in the
look-up table. The actual p-value is smaller than the p-value
returned.

  kpsstest = kpss(timeseries, regression='c')
```

```
#understood that data is non stationary
#so coverting to stationary data

# Diffrencing :

data['value_diff'] = data['value'] - data['value'].shift(1)
data['value_diff'].dropna().plot()
```

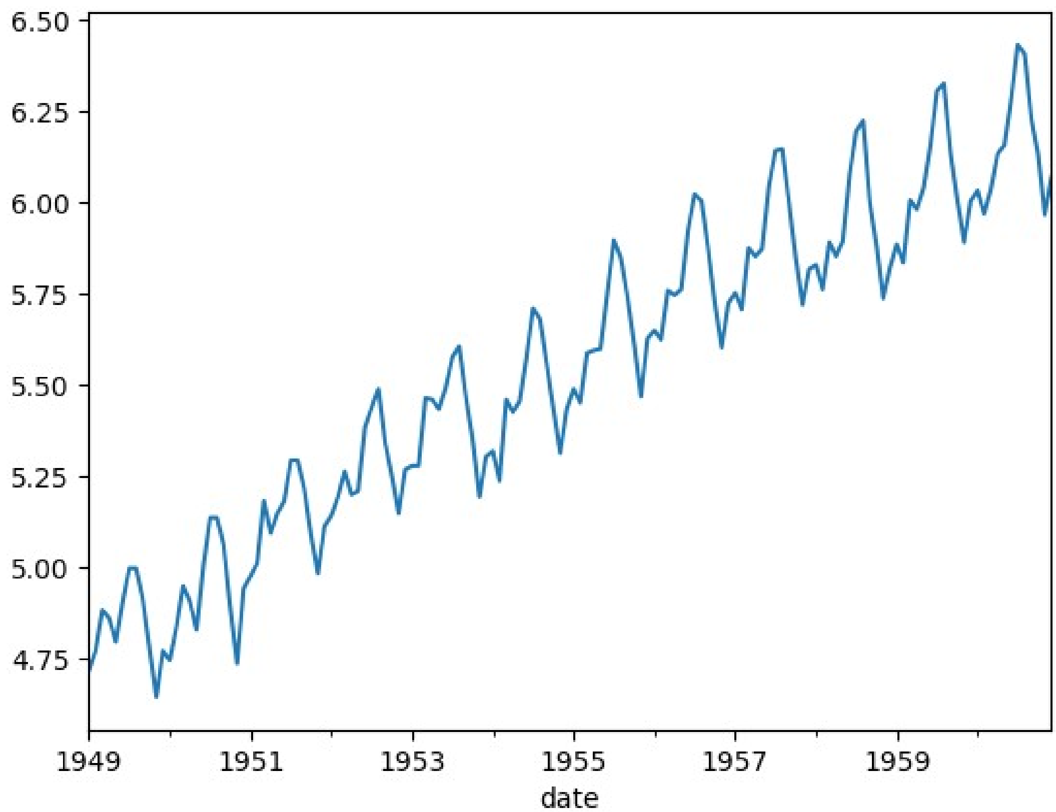
```
<Axes: xlabel='date'>
```




```
#infering that when time passes the diffrence increases:
    # when time is passing more passengers started to travel

#sesonal difference :

data['value_diff_n'] = data['value'] - data['value'].shift(4)
data['value_diff_n'].dropna().plot()

<Axes: xlabel='date'>
```

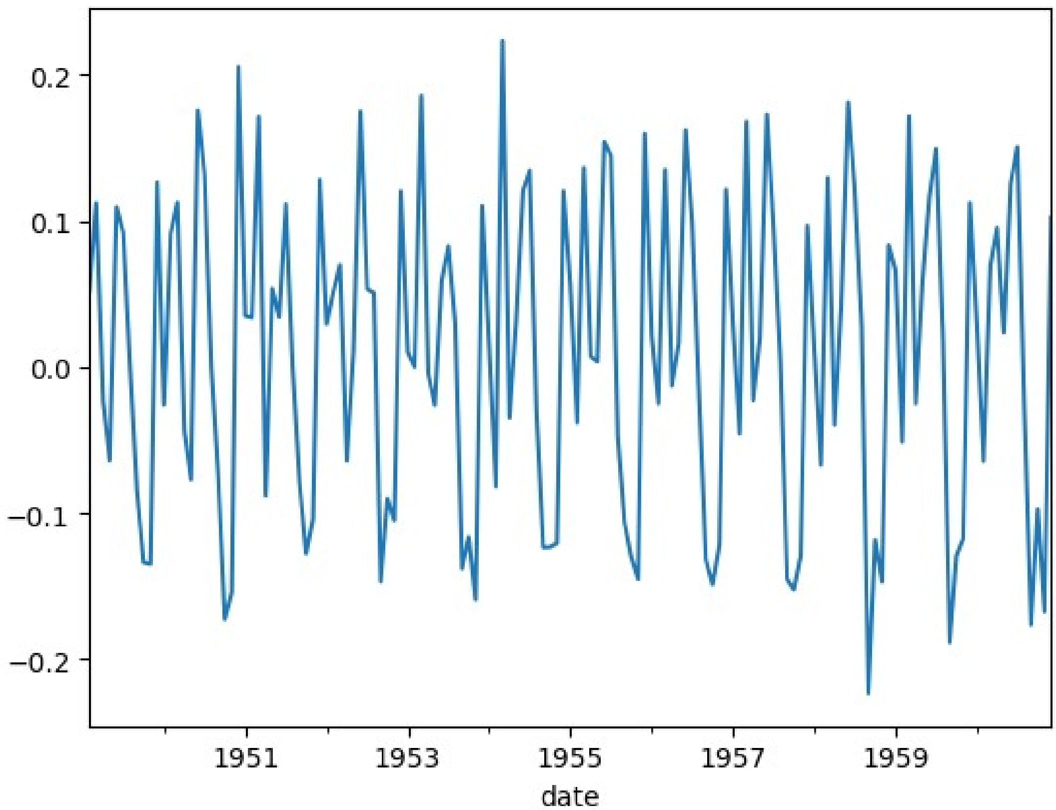



```
import numpy as np

#create a coloumn as log column which has logrithemic value of actual
value
data['log_column'] = np.log(data['value'])
data['log_column'].plot()

<Axes: xlabel='date'>
```

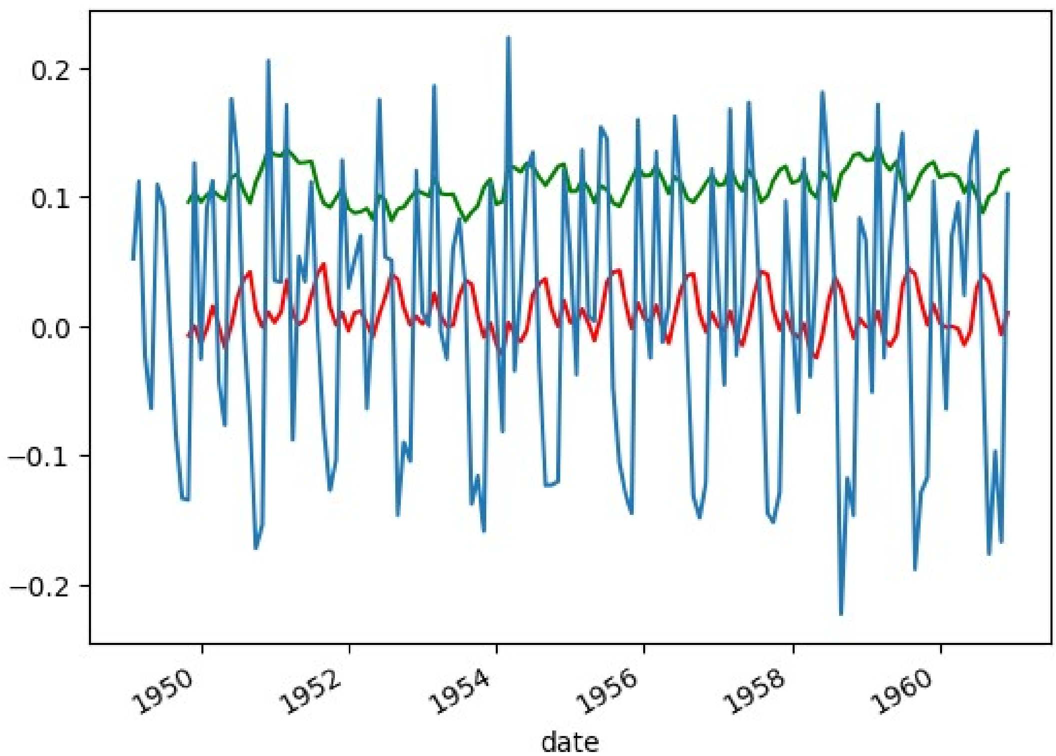



```
#find the difference of logrthemic value and plot it
data['log_diff'] = data['log_column'] - data['log_column'].shift(1)
data['log_diff'].dropna().plot()
```

```
<Axes: xlabel='date'>
```




```
#with this log difference value find moving average and moving
standard deviation and plot it
movingAverage = data['log_diff'].rolling(window=10).mean()
movingSTD = data['log_diff'].rolling(window=10).std()
plt.plot(movingAverage,color='red',label='movingAverage')
plt.plot(movingSTD,color='green',label='movingSTD')
data['log_diff'].dropna().plot()

plt.show()
```


0.2
0.1
0.0
−0.1
−0.2
1950
1952
1954
1956
1958
1960
date