24MDT0184_Regression_lab_28_March

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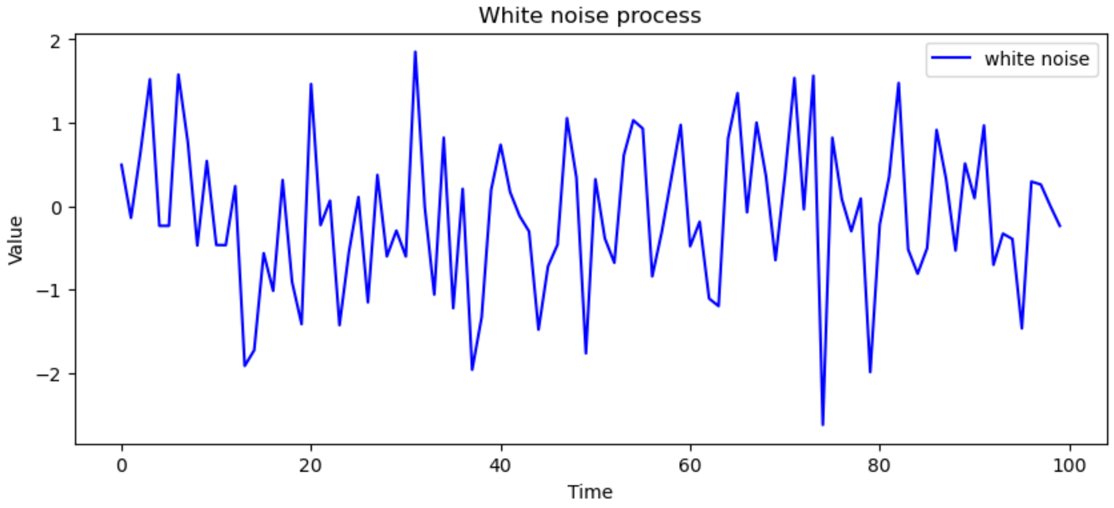
2.1 28 March, 2025

3 Visualization of Different Time Series Models

3.1 White noise process

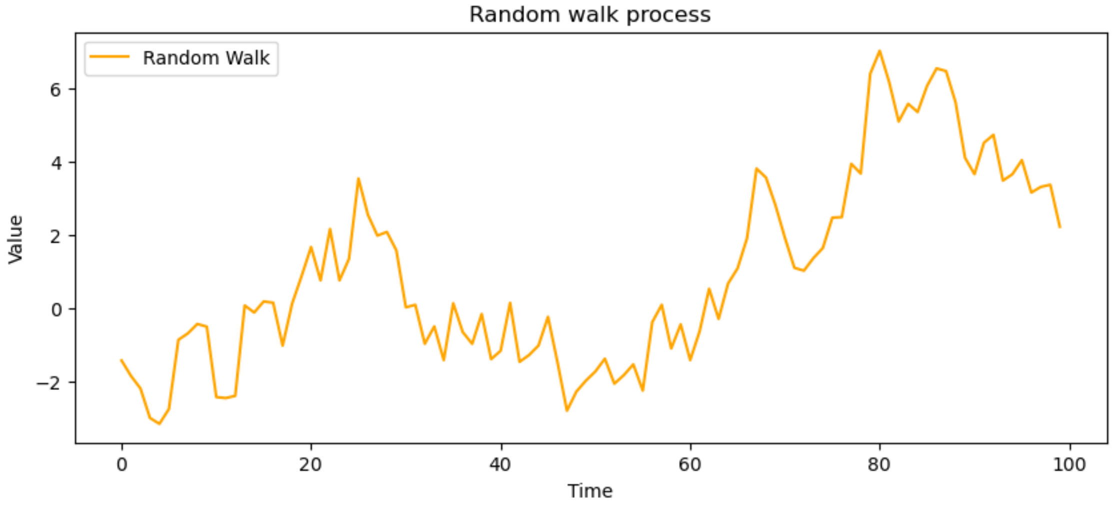
[3]:

```
import numpy as np
import matplotlib.pyplot as plt

np.random.seed(42)

white_noise = np.random.normal(loc = 0, scale = 1, size = 100)
# generates 100 dats points from normal distribution with mean 0 and standard␣
  ↪deviation 1
plt.figure(figsize = (10,4))
plt.plot(white_noise, label = 'white noise', color = 'b')
plt.title("White noise process")
plt.xlabel("Time")
plt.ylabel("Value")
plt.legend()
plt.show()
```



4 Random Walk

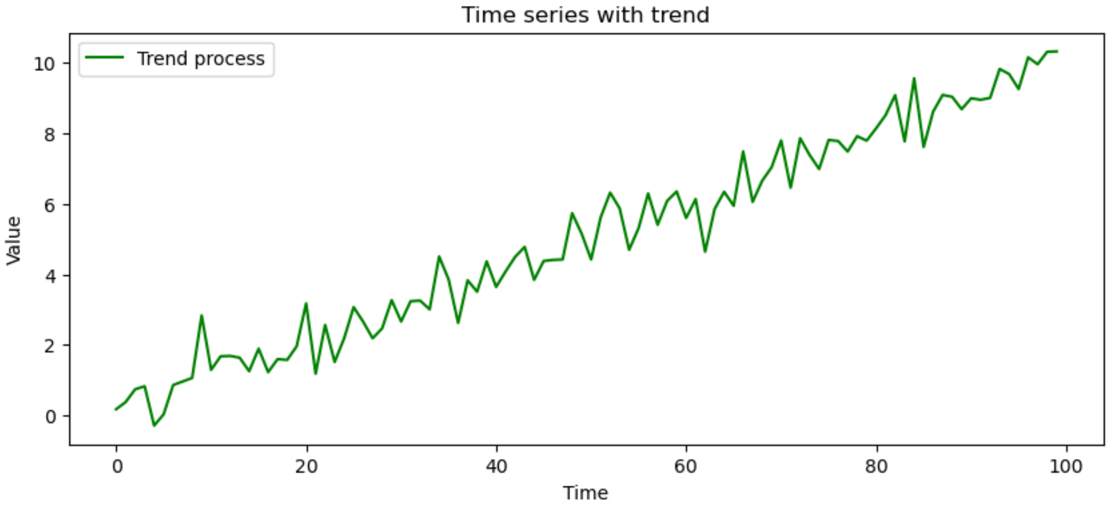
[6]:
```python
random_walk = np.cumsum(np.random.normal(loc = 0, scale = 1, size = 100))
# np.cumsum computes the cumulative sum, converting white noise into a random walk.
# each value is the sum of the previous value plus a new random step
plt.figure(figsize = (10,4))
plt.plot(random_walk, label = 'Random Walk', color = 'orange')
plt.title("Random walk process")
plt.xlabel("Time")
plt.ylabel("Value")
plt.legend()
plt.show()
```



5 Trend process

[8]:

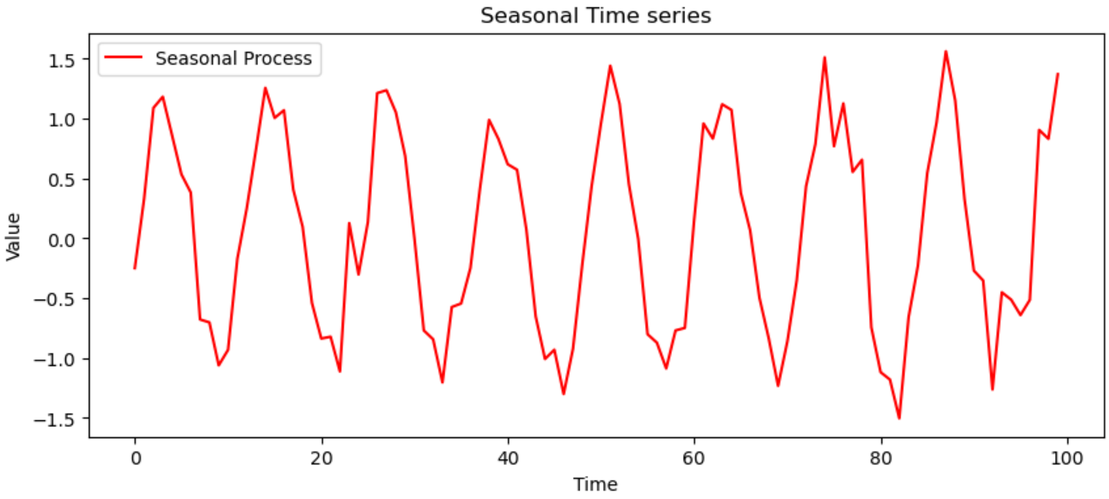
```
trend = np.linspace(start = 0, stop = 10, num = 100) + np.random.normal(scale =␣
 ↪0.5, size = 100)
plt.figure(figsize = (10,4))
plt.plot(trend, label = 'Trend process', color = 'green')
plt.title("Time series with trend")
plt.xlabel("Time")
plt.ylabel("Value")
plt.legend()
plt.show()
```



6 Seasonal component

[10]:

```
time = np.arange(100)
seasonal = np.sin(2*np.pi*time/12)+ np.random.normal(scale = 0.3, size = 100)
plt.figure(figsize = (10,4))
plt.plot(seasonal, label = 'Seasonal Process', color = 'red')
plt.title("Seasonal Time series")
plt.xlabel("Time")
plt.ylabel("Value")
plt.legend()
plt.show()
```



7 Moving average

[23]:
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
import statsmodels.api as sm
from statsmodels.tsa.stattools import adfuller
from statsmodels.graphics.tsaplots import plot_acf, plot_pacf
```

[24]:
```
df_births = pd.read_csv(r"C:\Users\Batch1\Downloads\daily-total-female-births.
↪csv", index_col = 0, parse_dates = True)
df_air_passengers = pd.read_csv(r"C:\Users\Batch1\Downloads\AirPassengers.csv",␣
↪index_col = 0, parse_dates = True)

# Changing the index to datetime format
df_births.index = pd.to_datetime(df_births.index)
df_air_passengers.index = pd.to_datetime(df_air_passengers.index)

print("First few rows of Birth Data:")
print(df_births.head())
print("\nFirst few rows of Air Passengers Data:")
print(df_air_passengers.head())
```

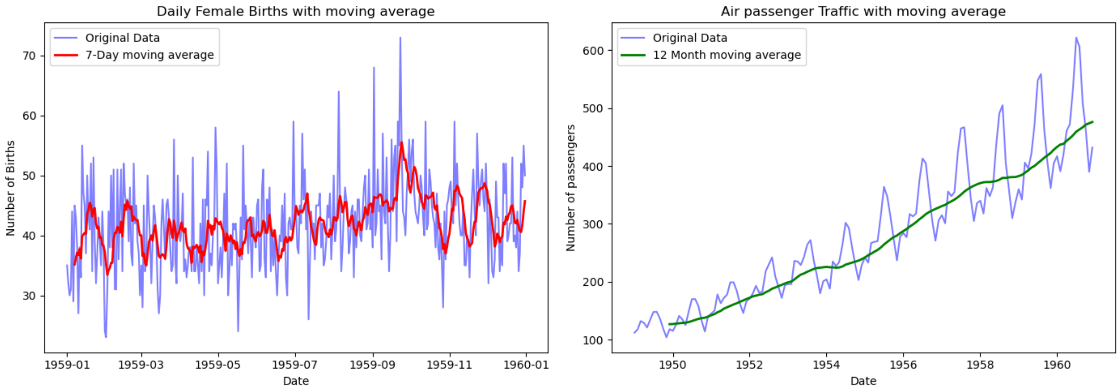
```
First few rows of Birth Data:
            Births
Date
1959-01-01      35
1959-01-02      32
```

```
1959-01-03      30
1959-01-04      31
1959-01-05      44

First few rows of Air Passengers Data:
            value
date
1949-01-01    112
1949-02-01    118
1949-03-01    132
1949-04-01    129
1949-05-01    121
```

7.1 Applying moving average

[25]:

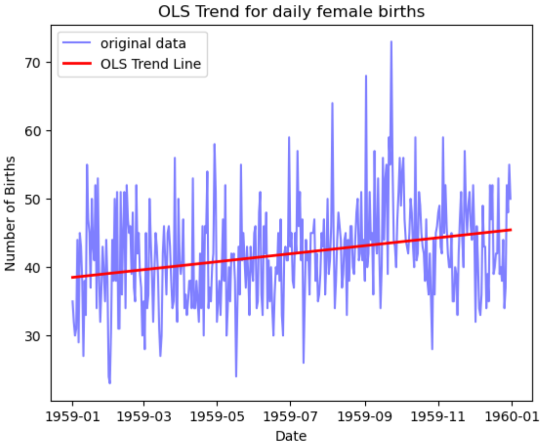
```
## Moving average with window of 7 days
df_births['MA_7'] = df_births.iloc[:,0].rolling(window = 7).mean()
df_air_passengers['MA_12'] = df_air_passengers.iloc[:,0].rolling(window = 12).
 ↪mean()

plt.figure(figsize = (14,5))
plt.subplot(1,2,1)
plt.plot(df_births.iloc[:,0], label = "Original Data", color = 'blue', alpha =␣
 ↪0.5)
plt.plot(df_births['MA_7'], label = "7-Day moving average", color = 'red',␣
 ↪linewidth = 2)
plt.title("Daily Female Births with moving average")
plt.xlabel("Date")
plt.ylabel("Number of Births")
plt.legend()

plt.subplot(1,2,2)
plt.plot(df_air_passengers.iloc[:,0], label = "Original Data", color = 'blue',␣
 ↪alpha = 0.5)
plt.plot(df_air_passengers['MA_12'], label = "12 Month moving average", color =␣
 ↪'green', linewidth = 2)
plt.title("Air passenger Traffic with moving average")
plt.xlabel("Date")
plt.ylabel("Number of passengers")
plt.legend()
plt.tight_layout()
plt.show()
```

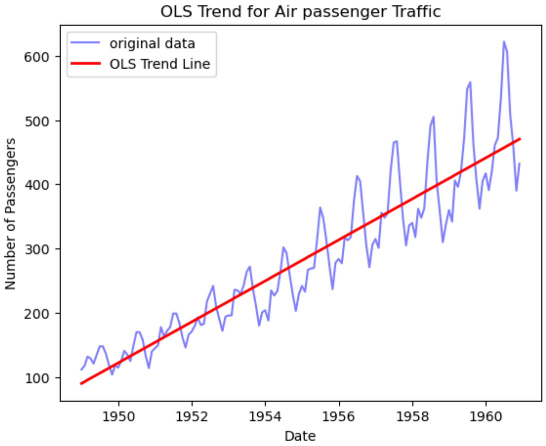


8 OLS Trend

[34]:

```
## ---------------------------------- OLS TREND CALCULATION␣
  ↪------------------------------------------- ##
df_births['Time'] = np.arange(len(df_births))
df_air_passengers['Time'] = np.arange(len(df_air_passengers))
x_births = sm.add_constant(df_births['Time'])
y_births = df_births.iloc[:,0]
model_births = sm.OLS(y_births,x_births).fit()
df_births['OLS_Trend'] = model_births.fittedvalues

x_air = sm.add_constant(df_air_passengers['Time'])
y_air = df_air_passengers.iloc[:,0]
model_air = sm.OLS(y_air, x_air).fit()
df_air_passengers['OLS_Trend'] = model_air.fittedvalues

# Plot of original data and OLS trend

## Plot for daily birth data
plt.figure(figsize = (14,5))
plt.subplot(1,2,1)
plt.plot(df_births.iloc[:,0], label = "original data", color = 'blue', alpha =␣
  ↪0.5)
plt.plot(df_births['OLS_Trend'], label = 'OLS Trend Line', color = 'red',␣
  ↪linewidth = 2)
plt.title("OLS Trend for daily female births")
plt.xlabel("Date")
plt.ylabel("Number of Births")
plt.legend()

## Plot for air passenger data
plt.subplot(1,2,2)
plt.plot(df_air_passengers.iloc[:,0], label = "original data", color = 'blue', alpha = 0.5)
plt.plot(df_air_passengers['OLS_Trend'], label = 'OLS Trend Line', color = 'red', linewidth = 2)
plt.title("OLS Trend for Air passenger Traffic")
plt.xlabel("Date")
plt.ylabel("Number of Passengers")
plt.legend()
plt.show()
```


OLS Trend for daily female births
original data
OLS Trend Line
Number of Births
Date


OLS Trend for Air passenger Traffic
original data
OLS Trend Line
Number of Passengers
Date