NAME: GAAYATHRI AG

REG NO : 24MSD7007

SUBJECT : TIME SERIES (assignment 2)

WHITE NOISE SERIES

```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import statsmodels.api as sm #Used for ACF & PACF plots
from statsmodels.tsa.stattools import adfuller #Used for Augmented
Dickey-Fuller (ADF) test to check for stationarity.
```

Create a series of 1,000 random Gaussian variables with mean=0 and standard deviation=1. Set appropriate seed.

```
# set seed
np.random.seed(42)

#generating white noise
white_noise = np.random.normal(loc=0,scale=1,size =1000) # loc is
mean=0,scale is sd =1, size = 1000 samples, guassian normal dist
white_noise_series = pd.Series(white_noise)
```

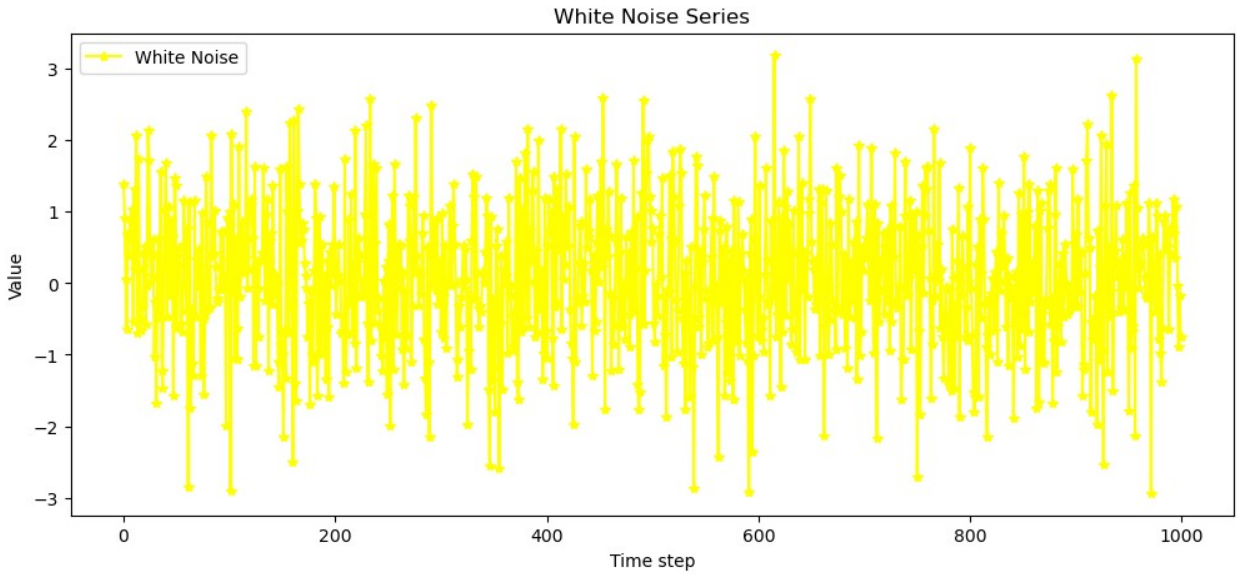
Printing Summary Statistics

```
print("White noise series Statistics: \n" ,
white_noise_series.describe())
```

```
White noise series Statistics:
 count    1000.000000
mean        0.070836
std         0.997454
min        -2.940389
25%        -0.606242
50%         0.063077
75%         0.728882
max         3.193108
dtype: float64
```

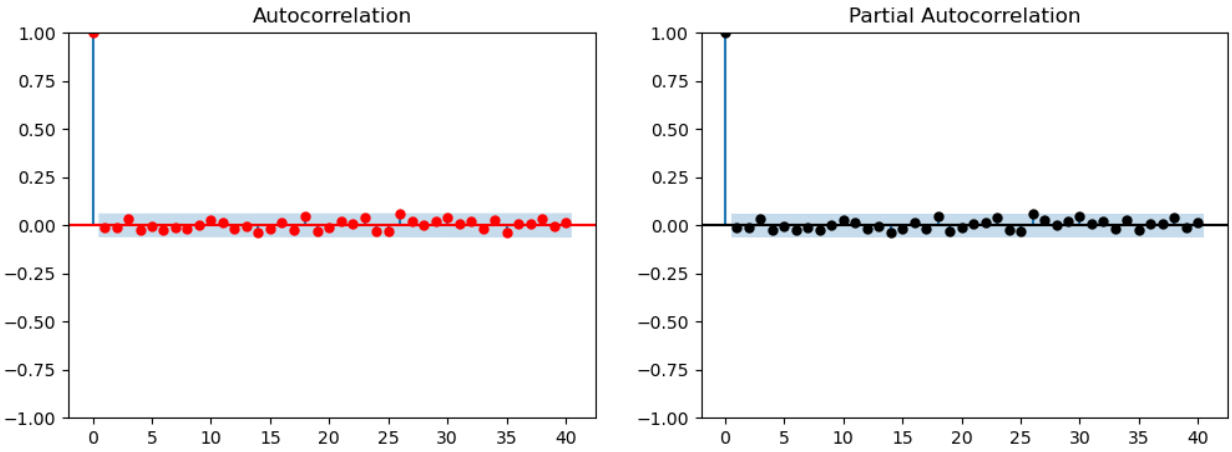
create a line plot of the given series

```
plt.figure(figsize=(12,5))
plt.plot(white_noise_series,label = "White Noise", color =
"yellow",marker = "*")
plt.title("White Noise Series")
plt.xlabel("Time step")
plt.ylabel("Value")
plt.legend()
plt.show()
```



Create the ACF and PACF plots

```
fig,axes = plt.subplots(1,2,figsize =(12,4)) #Creates two subplots
(ACF & PACF) side by side
sm.graphics.tsa.plot_acf(white_noise_series, lags = 40,ax =
axes[0],color= "red") # plots acf for 40 lags
sm.graphics.tsa.plot_pacf(white_noise_series, lags = 40,ax =
axes[1],color = "black") #plots pacf with 40 lags
plt.show()
```



Stationarity Test Using ADF (Augmented Dickey-Fuller)

```
adf_result = adfuller(white_noise_series)
print("White Noise ADF Statistic:", adf_result[0])
print("White Noise p-value:", adf_result[1])
print("White Noise Critical Values:", adf_result[4])
```

```
White Noise ADF Statistic: -32.0477346389986
White Noise p-value: 0.0
White Noise Critical Values: {'1%': -3.4369127451400474, '5%': -
2.864437475834273, '10%': -2.568312754566378}
```

p-value < 0.05 → White Noise is stationary

ADF Statistic is very negative

RANDOM WALK

Create and plot a random walk of 1000 timesteps. Set appropriate seed.

```
random_steps = np.random.normal(loc= 0,scale=1,size = 1000) # loc is
mean ,scale is sd
random_walk = np.cumsum(random_steps) # np.cumsum gives cumulative sum
of the steps
random_walk_series = pd.Series(random_walk) # using pandas create a
series
```

Random Walk is non-stationary because each step depends on the previous one

Print the summary statistics

```
print("Random walk series Statistics: \n" ,
random_walk_series.describe())
```

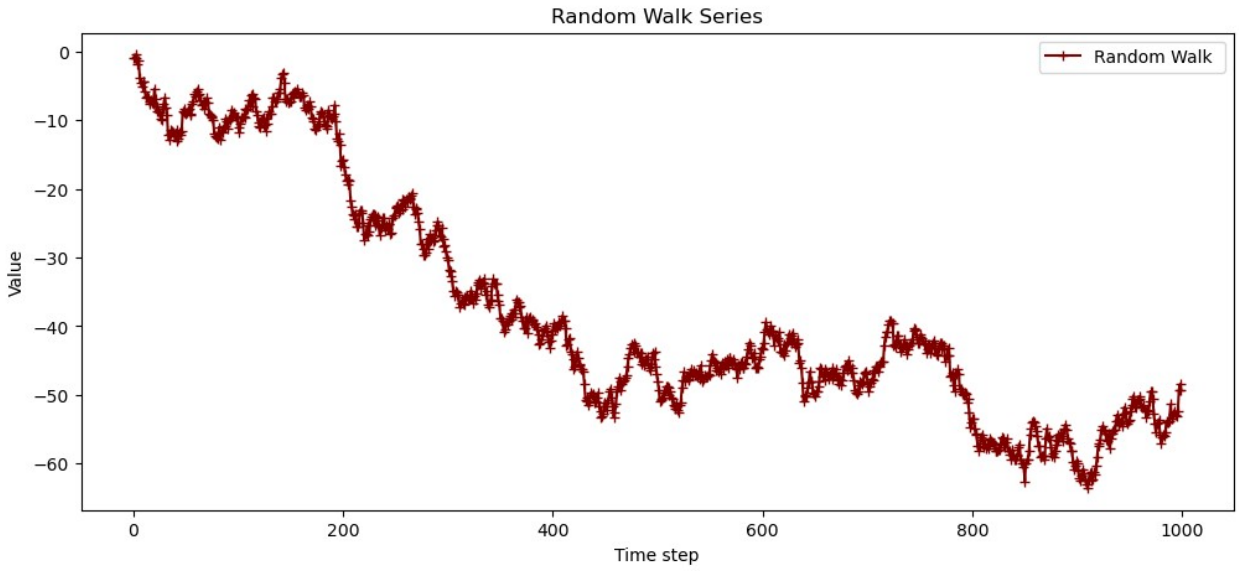
```
Random walk series Statistics:
 count    1000.000000
mean      -37.483332
```

```
std        17.106333
min       -63.625017
25%       -49.808486
50%       -43.181135
75%       -24.733072
max        -0.404050
dtype: float64
```

create a line plot of the given series

```
plt.figure(figsize= (12,5))
plt.plot(random_walk_series, label = "Random Walk ",color =
"maroon",marker= "+")
plt.title("Random Walk Series")
plt.xlabel("Time step")
plt.ylabel("Value")
plt.legend()
plt.show
```

```
<function matplotlib.pyplot.show(close=None, block=None)>
```

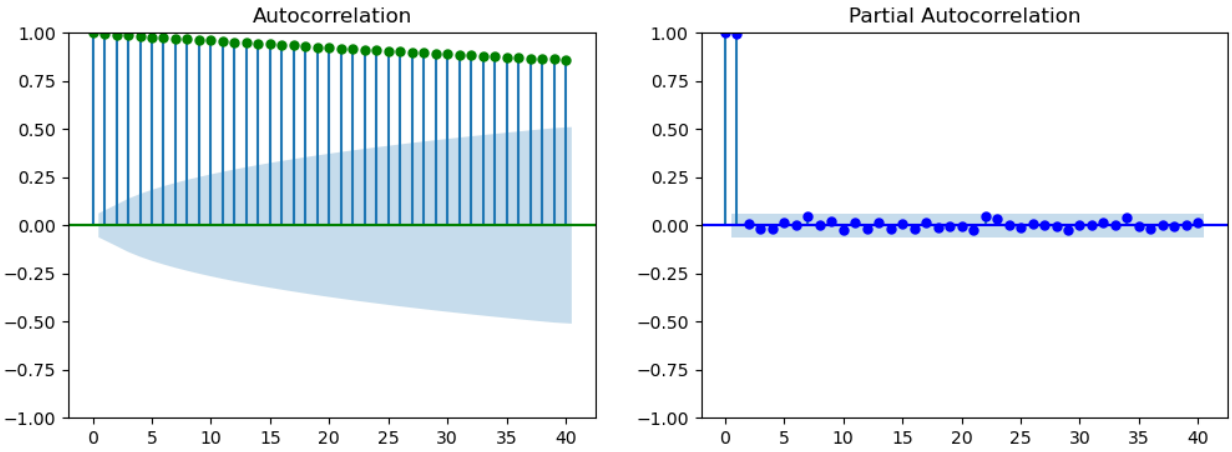


A trending, non-stationary series moving randomly up and down over time.

Plotting ACF & PACF

```
fig,axes = plt.subplots(1,2,figsize=(12,4))
sm.graphics.tsa.plot_acf(random_walk_series,lags = 40,ax
=axes[0],color = "green") # plots acf for 40 lags
sm.graphics.tsa.plot_pacf(random_walk_series,lags = 40,ax =
axes[1],color = "blue") #plots pacf for 40 lags
plt.show
```

```
<function matplotlib.pyplot.show(close=None, block=None)>
```



ACF - Strong positive autocorrelation (gradually decreasing).

PACF - First lag is significant, followed by smaller lags.

Stationarity Test for Random Walk

```
adf_result_rw = adfuller(random_walk_series)
print("Random Walk ADF Statistic:", adf_result_rw[0])
print("Random Walk p-value:", adf_result_rw[1])
print("Random Walk Critical Values:", adf_result_rw[4])
```

```
Random Walk ADF Statistic: -2.04078264031589
Random Walk p-value: 0.268982423118442
Random Walk Critical Values: {'1%': -3.4369127451400474, '5%': -
2.864437475834273, '10%': -2.568312754566378}
```

p-value > 0.05 → Random Walk is NOT stationary.

ADF Statistic closer to 0 (not very negative)

What are the main differences that you observed in the plots and statistical properties of the data both the cases?.

1. White Noise has no trend, while Random Walk has a trend.

2. White Noise ACF/PACF → No significant correlation.

3. Random Walk ACF → High autocorrelation

4. ADF Test confirms White Noise is stationary, but Random Walk is not.