

# TSA\_HW\_01-1,2

October 1, 2021

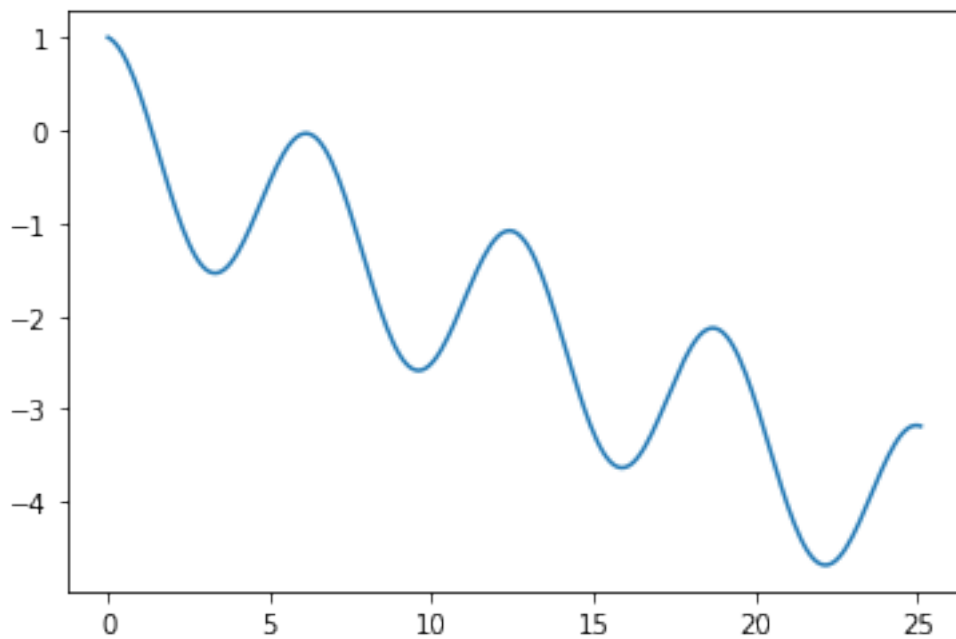
## 1 Time SeriesAnalytics Homework #01

### 1.1 Q1

```
[1]: import numpy as np
import matplotlib.pyplot as plt
import math
```

```
[2]: x = np.arange(0,8*np.pi,0.1)
y = np.cos(x)-x/6
```

```
[3]: plt.plot(x,y)
plt.show()
```



we may use cos function, and minus a certain x value to generate a alike curve, which similar to the question

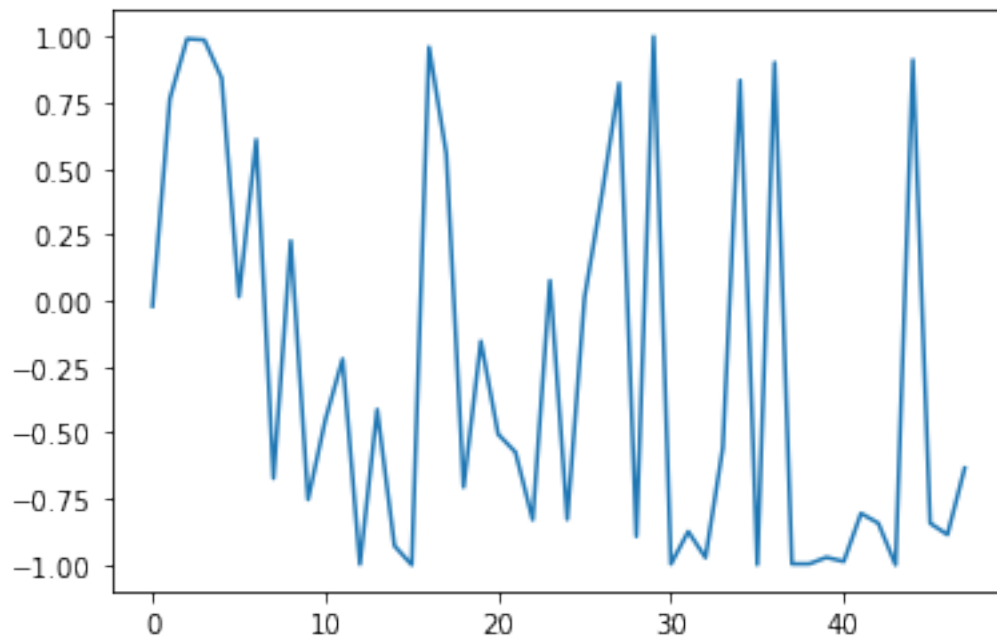
## 1.2 Q2

```
[4]: def Predict_a_Time_Series(Time_length):  
    #    predict a time series  
    predictions = []  
    for epoch in range(0,Time_length):  
        value = Make_Prediction(epoch)  
        predictions.append(value)  
    return predictions
```

```
[5]: def Make_Prediction(epoch):  
    #    return prediction value.  
    value = math.cos(2*math.pi*((epoch/12)+(np.random.uniform(0,1))))  
    return value
```

```
[6]: Predictions = Predict_a_Time_Series(48)
```

```
[7]: plt.plot(Predictions)  
plt.show()
```



we may discover a repeating pattern in this time series function

Q3.

$$\begin{aligned}\text{Cov}(X + Y, X - Y) \\ = \text{Cov}(X, X) - \text{Cov}(Y, Y) + \text{Cov}(X, Y) - \text{Cov}(X, Y) = V(X) - V(Y) = 0\end{aligned}$$

Q4.

$$\text{Corr}(X, Y) = \frac{\text{Cov}(X, Y)}{\sqrt{V(X)V(Y)}}, \text{Cov}(X, Y) = 12 \times 0.25 = 3$$

$$E(X^2) = V(X) + E(X)^2 = 9 + 3^2 = 18$$

$$E(XY) = \text{Cov}(X, Y) + E(X)E(Y) = 3 + 3 \times 4 = 15$$

a.  $V(X + Y)$

$$= V(X) + V(Y) + 2 \times \text{Cov}(X, Y) = 9 + 16 + 6 = 31$$

b.  $\text{Cov}(X, X + Y)$

$$= E(X^2 + XY) - E(X)E(X + Y)$$

$$= E(X^2) + E(XY) - E(X)^2 - E(X)E(Y)$$

$$= 18 + 15 - 9 - 12 = 12$$

c.  $\text{Corr}(X + Y, X - Y)$

$$= \frac{\text{Cov}(X + Y, X - Y)}{\sqrt{V(X + Y)V(X - Y)}}$$

$$= \frac{V(X) - V(Y)}{\sqrt{V(X) + V(Y) + 2 \times \text{Cov}(X, Y)} \times \sqrt{V(X) + V(Y) - 2 \times \text{Cov}(X, Y)}}$$

$$= \frac{9 - 16}{\sqrt{31} \times \sqrt{19}} = -0.288$$