Time Series Analytics - HW 01

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[1]:
```
# import packages needed
import math
import matplotlib.pyplot as plt
import numpy as np
import random
```

Q1

[2]:
```
def simulator(time_list, thershold):
    random.seed(seed_value)
    phi = random.uniform(0, 1.)
    output_list = []
    for index, time_unit in enumerate(time_list):
        value = math.cos(2 * math.pi * ((time_unit / 12) + phi)) + (time_list[-1] - time_unit) * thershold
        output_list.append(np.around(value, decimals=4))
    return output_list
```

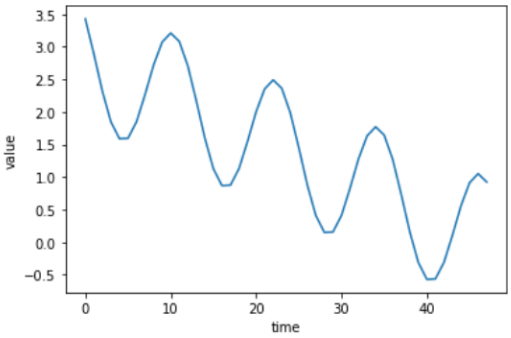
[3]:
```
seed_value = 100
time_list = [i for i in range(48)]
thershold = 0.06

output_list = simulator(time_list=time_list,
                        thershold=thershold)

print(output_list, '\n')

plt.plot(output_list)
plt.xlabel('time')
plt.ylabel('value')
plt.show()
```

```
[3.4296, 2.8915, 2.3183, 1.8473, 1.5887, 1.5957, 1.8504, 2.2685, 2.7217, 3.0727, 3.2113, 3.0843, 2.7096, 2.1715, 1.5983, 1.1273, 0.8687, 0.8757, 1.1304, 1.5485, 2.0017, 2.3527, 2.4913, 2.3643, 1.9896, 1.4515, 0.8783, 0.4073, 0.1487, 0.1557, 0.4104, 0.8285, 1.2817, 1.6327, 1.7713, 1.6443, 1.2696, 0.7315, 0.1583, -0.3127, -0.5713, -0.5643, -0.3096, 0.1085, 0.5617, 0.9127, 1.0513, 0.9243]
```



Q2

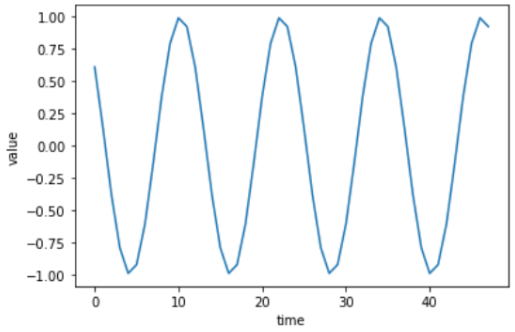
[4]:
```
seed_value = 100
time_list = [i for i in range(48)]
thershold = 0

output_list = simulator(time_list=time_list,
                        thershold=thershold)

print(output_list, '\n')

plt.plot(output_list)
plt.xlabel('time')
plt.ylabel('value')
plt.show()
```

```
[0.6096, 0.1315, -0.3817, -0.7927, -0.9913, -0.9243, -0.6096, -0.1315, 0.3817, 0.7927, 0.9913, 0.9243, 0.6096, 0.1315, -0.3817, -0.7927, -0.9913,
-0.9243, -0.6096, -0.1315, 0.3817, 0.7927, 0.9913, 0.9243, 0.6096, 0.1315, -0.3817, -0.7927, -0.9913, -0.9243, -0.6096, -0.1315, 0.3817, 0.7927,
0.9913, 0.9243, 0.6096, 0.1315, -0.3817, -0.7927, -0.9913, -0.9243, -0.6096, -0.1315, 0.3817, 0.7927, 0.9913, 0.9243]
```



Q3 $V(X)=V(Y)$, ask $COV(X+Y, X-Y)$

$$COV(X+Y,\ X-Y) = COV(X,\ X-Y) + COV(Y,\ X-Y)$$

$$= COV(X,\ X) - COV(X,\ Y) + COV(Y,\ X) - COV(Y,\ Y)$$

$$= Var(X) - Var(Y) \quad \#$$

Q4 $E(X)=3,\ V(X)=9,\ E(Y)=4,\ V(Y)=16,\ Corr(X,Y)=0.25$

(a) $V(X+Y)$

$$Corr(X,Y) = \frac{COV(X,Y)}{\sqrt{V(X)\cdot V(Y)}} \Rightarrow 0.25 = \frac{COV(X,Y)}{\sqrt{9\times 16}} \Rightarrow 0.25\times 12 = COV(X,Y)$$

$$\Rightarrow 3 = COV(X,Y)$$

$$V(X+Y) = V(X)+V(Y)+2\cdot Cov(X,Y) = 9+16+6 = 31 \quad \#$$

(b) $COV[X,\ X+Y]$

$$COV(X,\ X+Y) = COV(X+Y,\ X) = COV(X,X) + COV(Y,X)$$

$$= Var(X) + 3 \Rightarrow 9+3 = 12 \quad \#$$

(c) $Corr(X+Y, X-Y)$

$$Corr(X+y, X-y) = \frac{cov(X+y, X-y)}{\sqrt{V(X+y)\cdot V(X-y)}} \Rightarrow \frac{(-7)}{\sqrt{28 \times 19}} = (-0,3034)$$

where $cov(X+y, X-y) = cov(X, X-y) + cov(y, X-y)$

$= cov(X, X) - cov(X, y) + cov(y, X) - cov(y, y)$.

$= 9 - 16 = (-7)$

and $V(X+y) = 28$

while $V(X-y) = V(X) + V(y) - 2Cov(X, y) = 9 + 16 - 6 = 19$ #