In [1]:
```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
```

$$Y_t = T_t + S_t + R_t, \quad t = 1, \ldots, 123$$

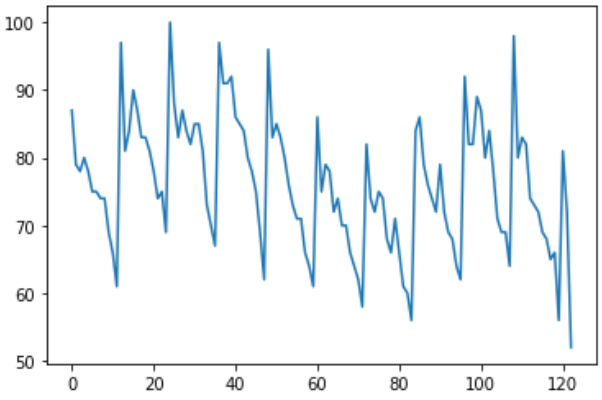
Πλήθος των μηνιαίων αναζητήσεων στο Google της λέξης "diet" από 01/2010 μέχρι και 03/2020

In [31]:
```
dataset = pd.read_csv('./diet.csv')
N=123
```

In [3]:
```
Y_t = np.array(dataset["diet"])
```

In [4]:
```
plt.plot(Y_t)
```

Out[4]:
```
[<matplotlib.lines.Line2D at 0x7f3f660df8d0>]
```



In [117]:
```
p = 12
```

In [118]:
```
s = p//2
print('p =', p)
print('s =', s)
```

```
p = 12
s = 6
```

- Απλός κινητός μέσος τάξης $2s + 1 = p$

$$a_u = \frac{1}{2s+1}, \quad u = -s, \ldots, s$$

- Απλός κινητός μέσος τάξης $2s = p$

$$a_u = \frac{1}{2s}, \quad u = -s+1, \ldots, s-1, \quad a_{-s} = a_s = \frac{1}{4s}$$

In [119]:
```
filt = 1/p * np.ones((2*s + 1))
if p%2==0:
    filt[0] /= 2
    filt[-1] /= 2
```

In [120]:
```
filt
```

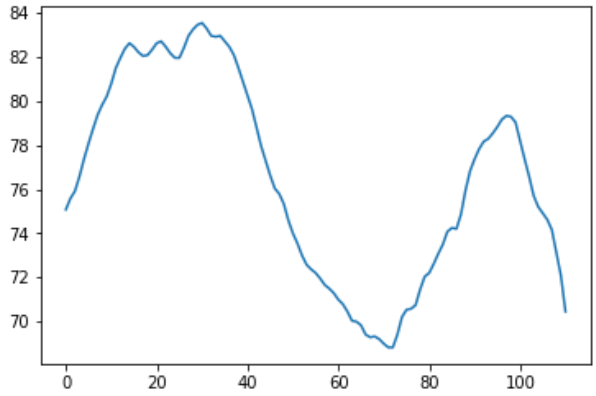
Out[120]:
```
array([0.04166667, 0.08333333, 0.08333333, 0.08333333, 0.08333333,
       0.08333333, 0.08333333, 0.08333333, 0.08333333, 0.08333333,
       0.08333333, 0.08333333, 0.08333333, 0.04166667])
```

$Y_t^* = \sum_{u=-s}^{s} a_u Y_{t-u}$

In [121]:
```
Y_star_t = np.convolve(Y_t,filt,'valid')
```

In [122]:
```
plt.plot(Y_star_t)
```

Out[122]:
```
[<matplotlib.lines.Line2D at 0x7f3f649d0350>]
```



$D_t = Y_t - Y_t^* \sim S_t + R_t,\ t = 1 + s, \ldots, N - s$

In [123]:
```
D_t = Y_t[s:-s] - Y_star_t
```

In [124]:
```
D_t.shape
```

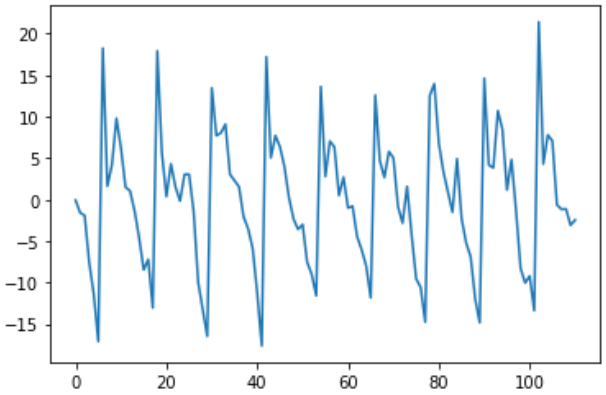
Out[124]:
```
(111,)
```

In [125]:
```
s
```

Out[125]:
```
6
```

In [126]:
```
plt.plot(D_t)
```

Out[126]:
```
[<matplotlib.lines.Line2D at 0x7f3f649bc790>]
```



$\bar{D}_t = \frac{1}{n_t} \sum_{j=0}^{n_t-1} D_{t+jp}, \quad t = s+1, \ldots, p$

$\bar{D}_t = \frac{1}{n_t} \sum_{j=0}^{n_t-1} D_{t+(j+1)p}, \quad t = 1, \ldots, s$

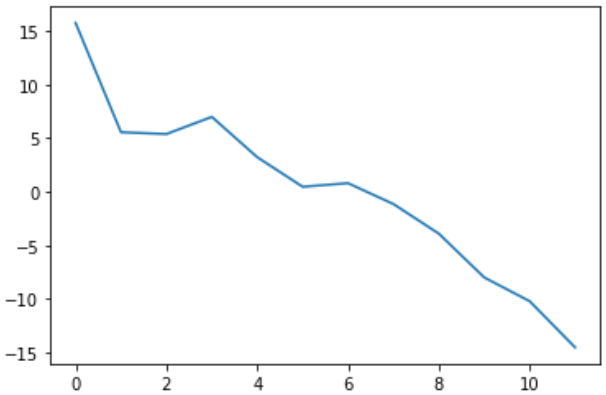
In [127]:
```
D_bar_t = []
for j in range(p): # j=0,1,...,p-1
    if j>=s:
        D_bar_t.append(D_t[(j-s)::p].mean())
    else:
        D_bar_t.append(D_t[(j+p-s)::p].mean())
D_bar_t = np.array(D_bar_t)
```

In [128]:
```
D_bar_t
```

Out[128]:
```
array([ 15.73611111,   5.55092593,   5.37962963,   6.98148148,
         3.22222222,   0.46759259,   0.8       ,  -1.14583333,
        -3.90833333,  -7.99074074, -10.2037037 , -14.50925926])
```

In [129]:
```
plt.plot(D_bar_t)
```

Out[129]:
```
[<matplotlib.lines.Line2D at 0x7f3f6492c810>]
```



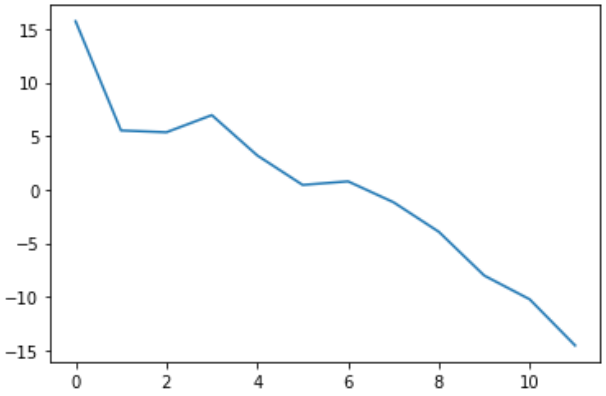
$$\hat{S}_t = \bar{D}_t - \frac{1}{p}\sum_{j=1}^{p} \bar{D}_j \sim S_t, \quad t = 1, \ldots, p$$

In [130]:
```
E_D_bar = D_bar_t.mean()
```

In [131]:
```
S_hat = D_bar_t - E_D_bar
```

In [132]:
```
plt.plot(S_hat)
```

Out[132]:
```
[<matplotlib.lines.Line2D at 0x7f3f6489d0d0>]
```



- Επεκτείνουμε σε όλο το μήκος της χρονολογικής σειράς

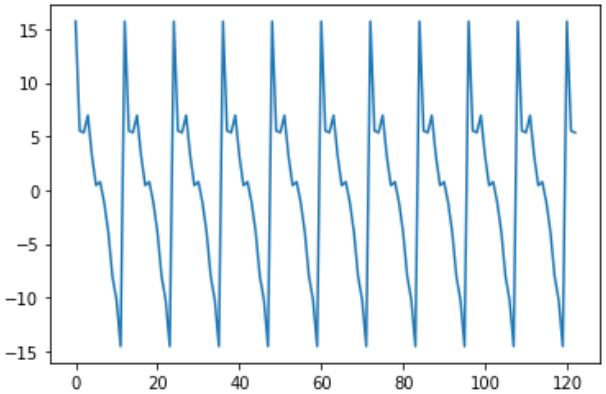
$$\hat{S}_{t+jp} = \hat{S}_t, \quad j = 1, 2, \ldots \quad t = 1, \ldots, p$$

In [133]:
```
S_hat_t = np.zeros((N,))
```

In [134]:
```
for i in range(N):
    S_hat_t[i] = S_hat[i%p]
```

In [135]:
```
plt.plot(S_hat_t)
```

Out[135]:
```
[<matplotlib.lines.Line2D at 0x7f3f64804850>]
```

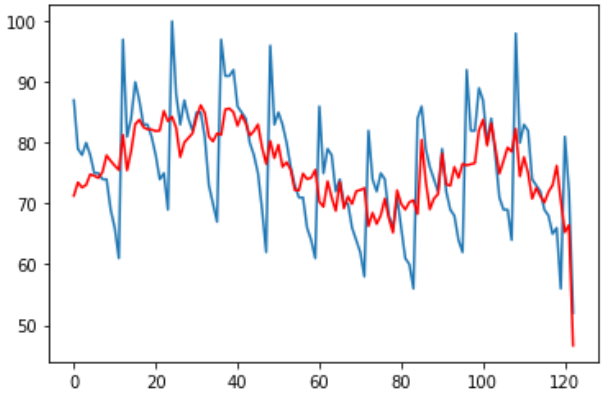


$$Y_t - \hat{S}_t \sim Y_t - S_t = T_t + R_t, \quad t = 1, \ldots, N$$

In [136]:
```
Y_minus_S_hat_t = Y_t - S_hat_t
```

In [137]:
```
plt.plot(Y_t)
plt.plot(Y_minus_S_hat_t,'r')
```

Out[137]:
```
[<matplotlib.lines.Line2D at 0x7f3f647f2d90>]
```



In [ ]: