Turbulência

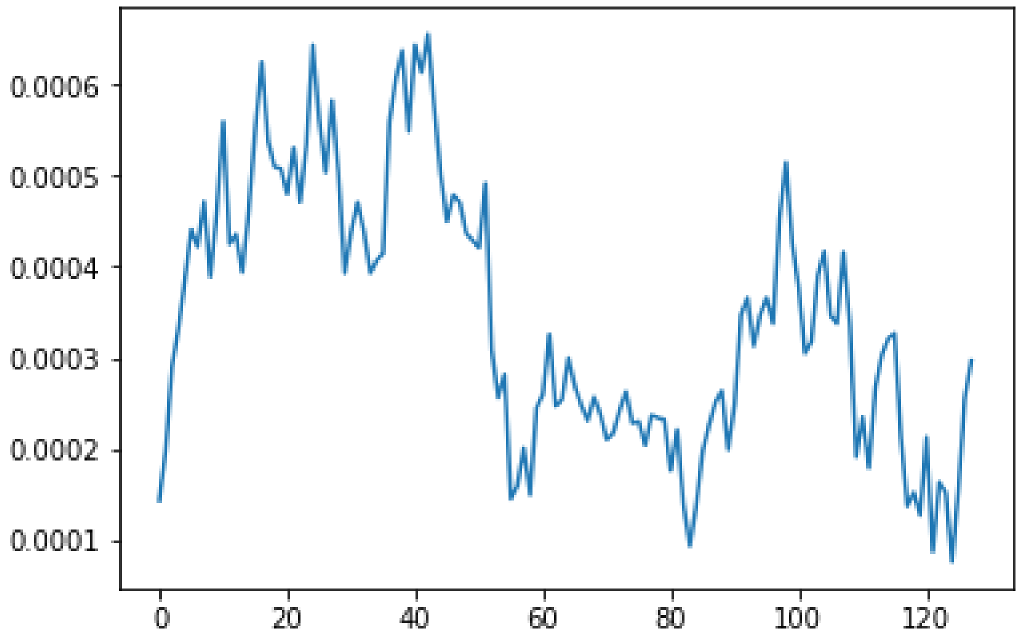
27 de maio de 2018

```
In [1]: from scipy.stats import moment
        from scipy.stats import kurtosis, skew, scoreatpercentile
        from scipy.stats import norm, lognorm, beta
        from scipy.optimize import minimize

        from numpy import zeros, fromiter, savetxt, loadtxt
        from IPython.display import Image

        import subprocess

        import numpy as np
        import pandas as pd
        import matplotlib.pyplot as plt
        import seaborn as sns

        import auxiliar_matcomp as aux

        #%matplotlib inline

        size = 2**12
        t = fromiter((i for i in range(0,size)), int, size)
```

1 Série Completa

1.1 Gerando série temporal e plotando resultado

```
In [2]: name = "A.ex:1.3.c"

        A = loadtxt("noise_equals_1_67.txt")

        savetxt(name + ".txt", A)

        save_A = A

In [3]: num_points = 128
        plt.plot(t[0:num_points], A[0:num_points])
        plt.show()
```



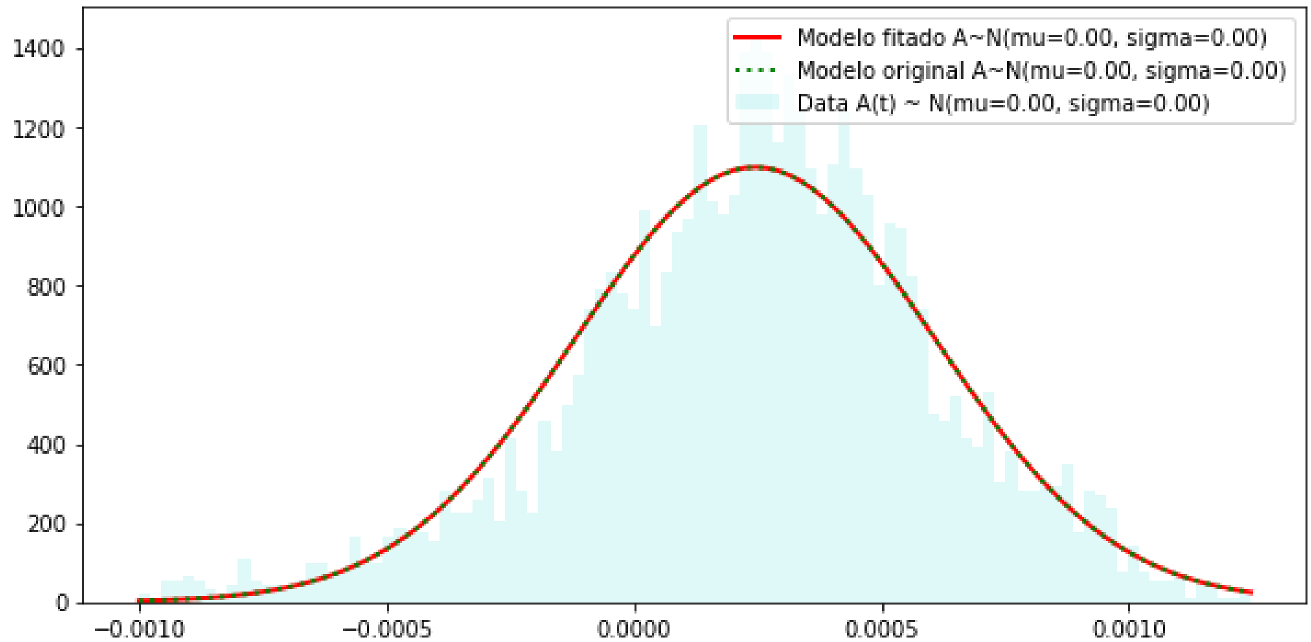
1.2 Calculando os momentos do ensemble

In [4]:
```
A_mean, A_var, A_skew, A_kurtosis = aux.calcMoments(A)

print("mean : ", A_mean)
print("var  : ", A_var)
print("skew : ", A_skew)
print("kurt : ", A_kurtosis)

A_Q1 = scoreatpercentile(A, 25)
A_Q3 = scoreatpercentile(A, 75)

print("Q1   : ", A_Q1)
print("Q3   : ", A_Q3)
```

```
mean :  0.000244136962891
var  :  1.3199607963e-07
skew :  -0.352073944946
kurt :  0.42935810211
Q1   :  2.575e-05
Q3   :  0.00047525
```

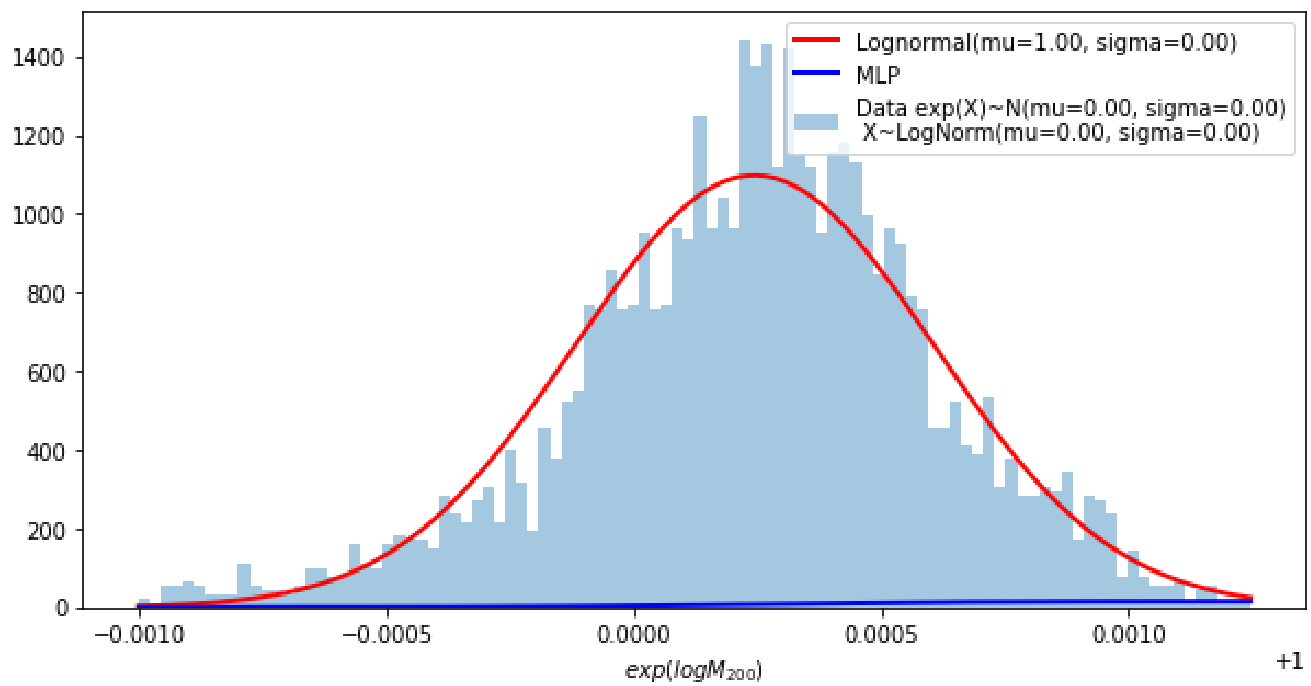
1.3 Fitando uma distribuição normal

In [5]:
```
aux.fitting_normal_distribution(A)
```



1.4 Fitando uma distribuição lognormal

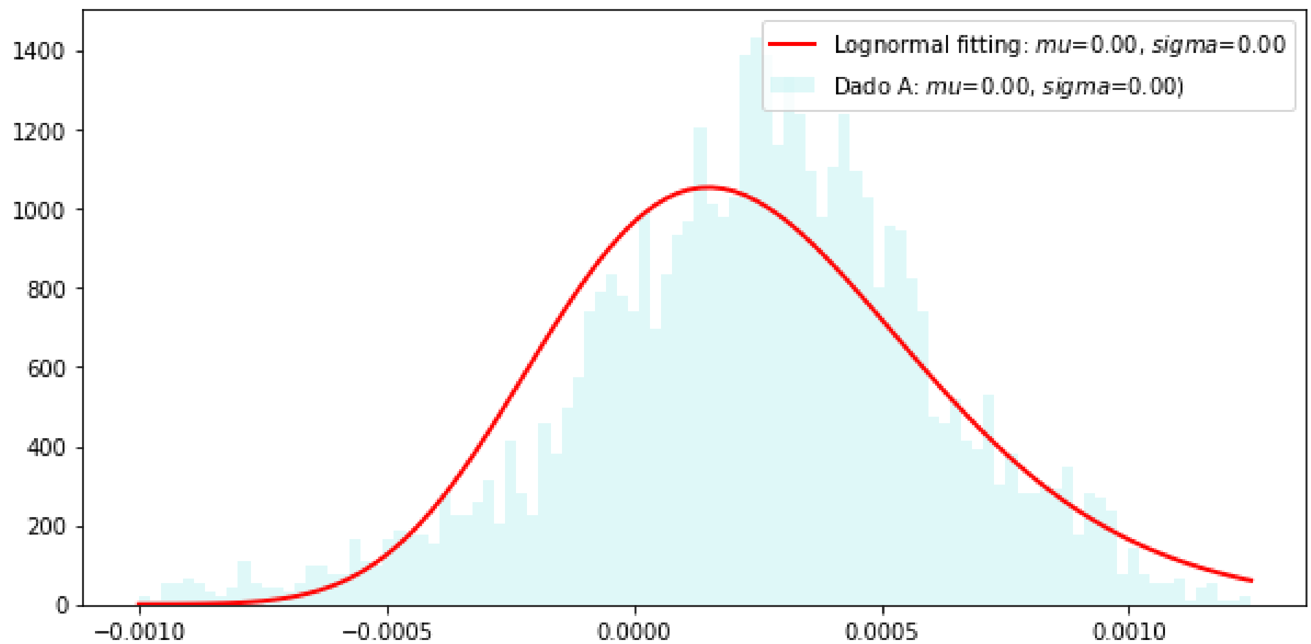
```
In [6]: aux.fitting_lognormal_and_mlp_distribution(A)
```



1.5 Fitando uma distribuição lognormal (utlizando minha implementação)

```
In [7]: aux.fitting_lognormal_distribution(A)
```

```
parametros de fitting:  (0.1684247027425318, -0.002067729901793775, 0.0022809004857261977)
        Fitado                         Original
mean :  0.00024575211256293045          0.000244136962891
var  :  1.5399910080257096e-07          1.3199607963e-07
skew :  0.5137593012465203          -0.35207394494638344
kurt :  0.4729307697920442          0.42935810210956493
```

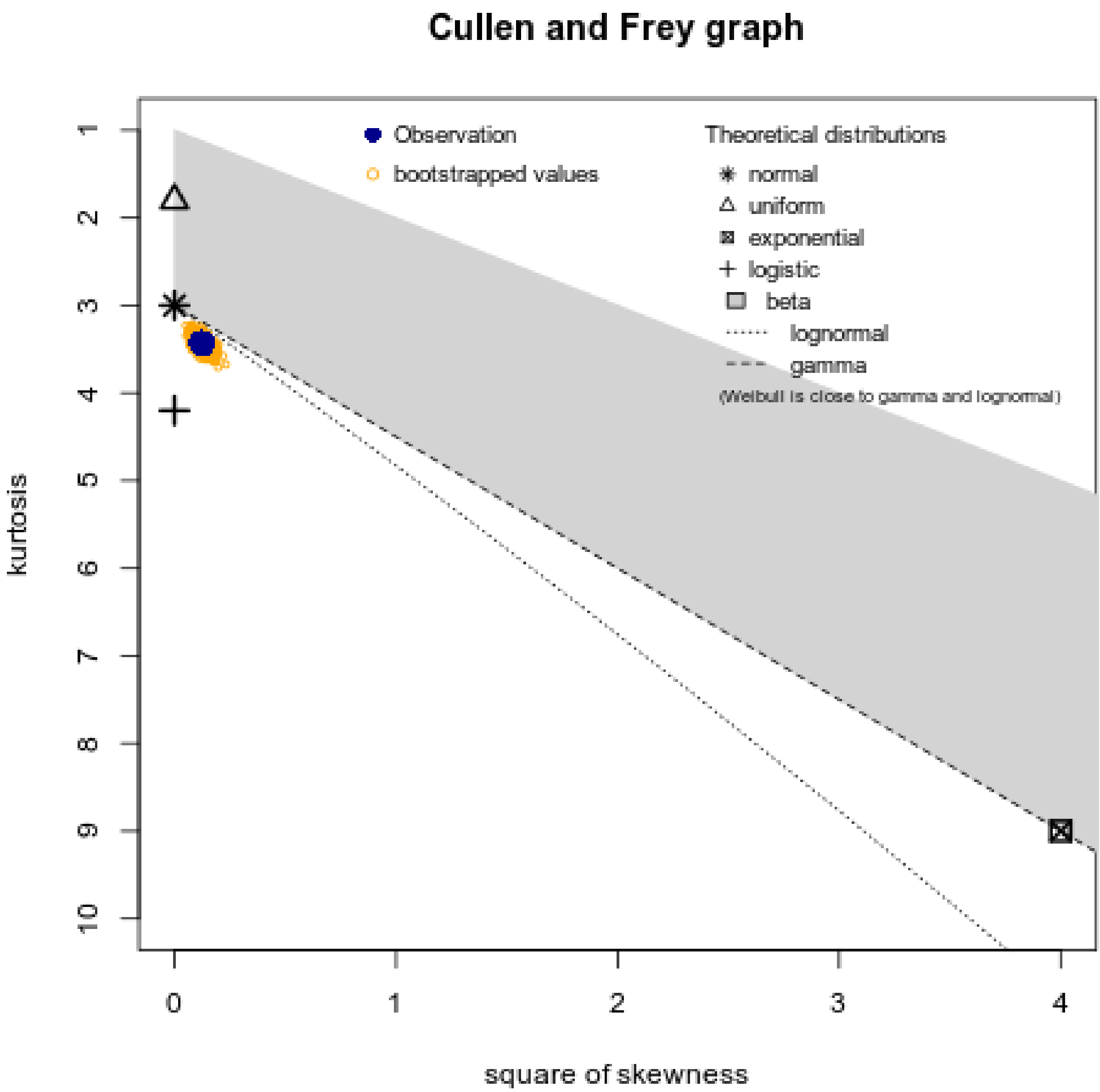


1.6 Plotando dados no espaço de Cullen-Frey

```
In [8]: command = 'Rscript'
        path_script = 'cullen_frey_script.R'

        # define arguments
        args = [name,]

        # build subprocess command
        cmd = [command, path_script] + args

        x = subprocess.check_output(cmd, universal_newlines=True)
        print(x)

        Image(name+".png")
```

```
summary statistics
------
min:  -0.001003   max:  0.001247
median:  0.0002625
mean:  0.000244137
estimated sd:  0.000363357
estimated skewness:  -0.3522029
estimated kurtosis:  3.431349
```

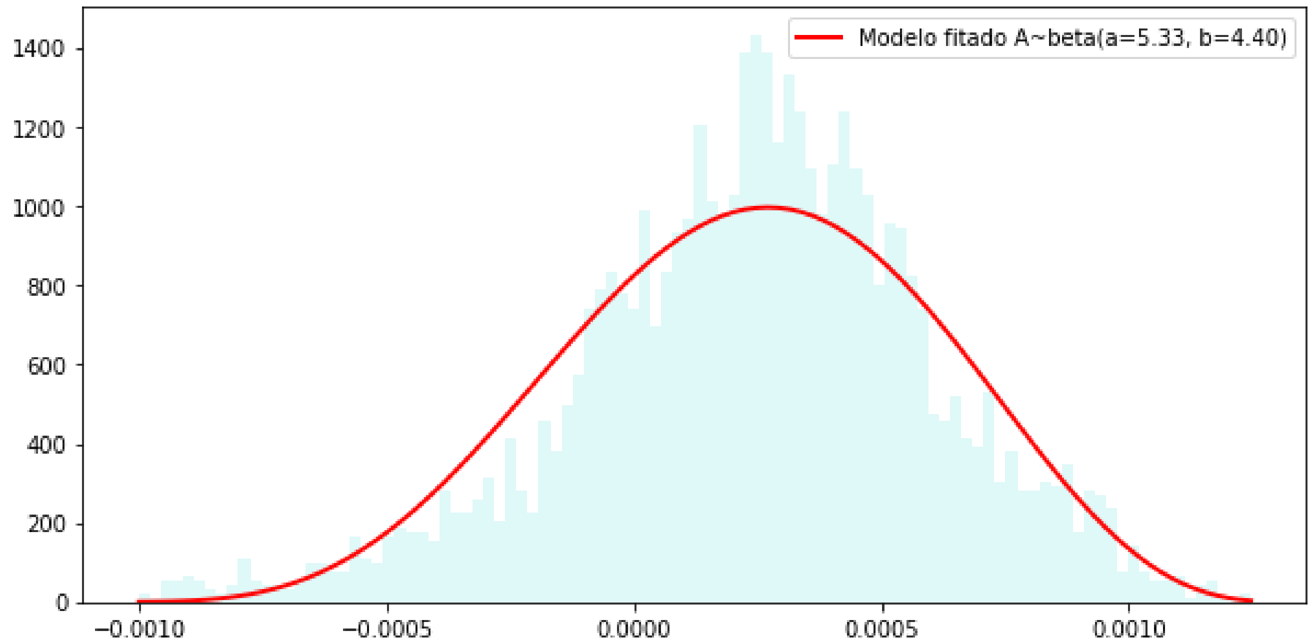
Out[8]:



1.7 Fitando melhor distribuição segundo método de Cullen-Frey

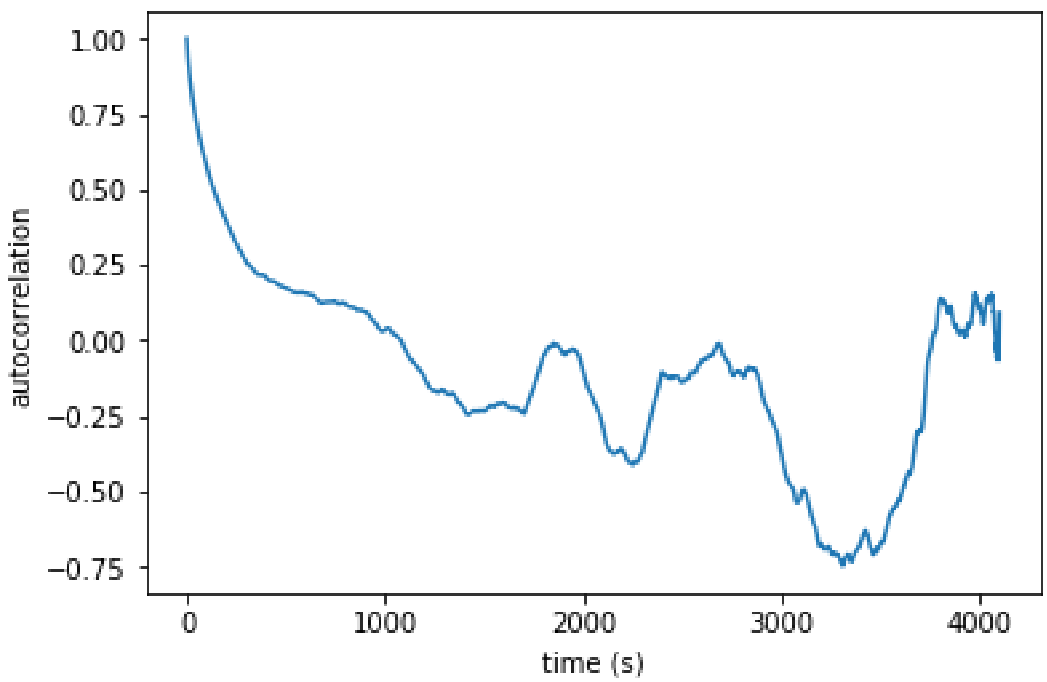
In [9]:
```
aux.fitting_beta_distribution(A)
```

```
parametros de fitting:  (5.3314803021402195, 4.3972427035224344, -0.001103, 0.0024500000000000004)
        Fitado                         Original
mean :  0.00023963528035906233          0.000244136962891
var  :  1.3858004722743925e-07          1.3199607963e-07
skew :  -0.10776965707253301          -0.35207394494638344
kurt :  -0.4553220817093983         0.42935810210956493
```



1.8 Calculando autocorrelação

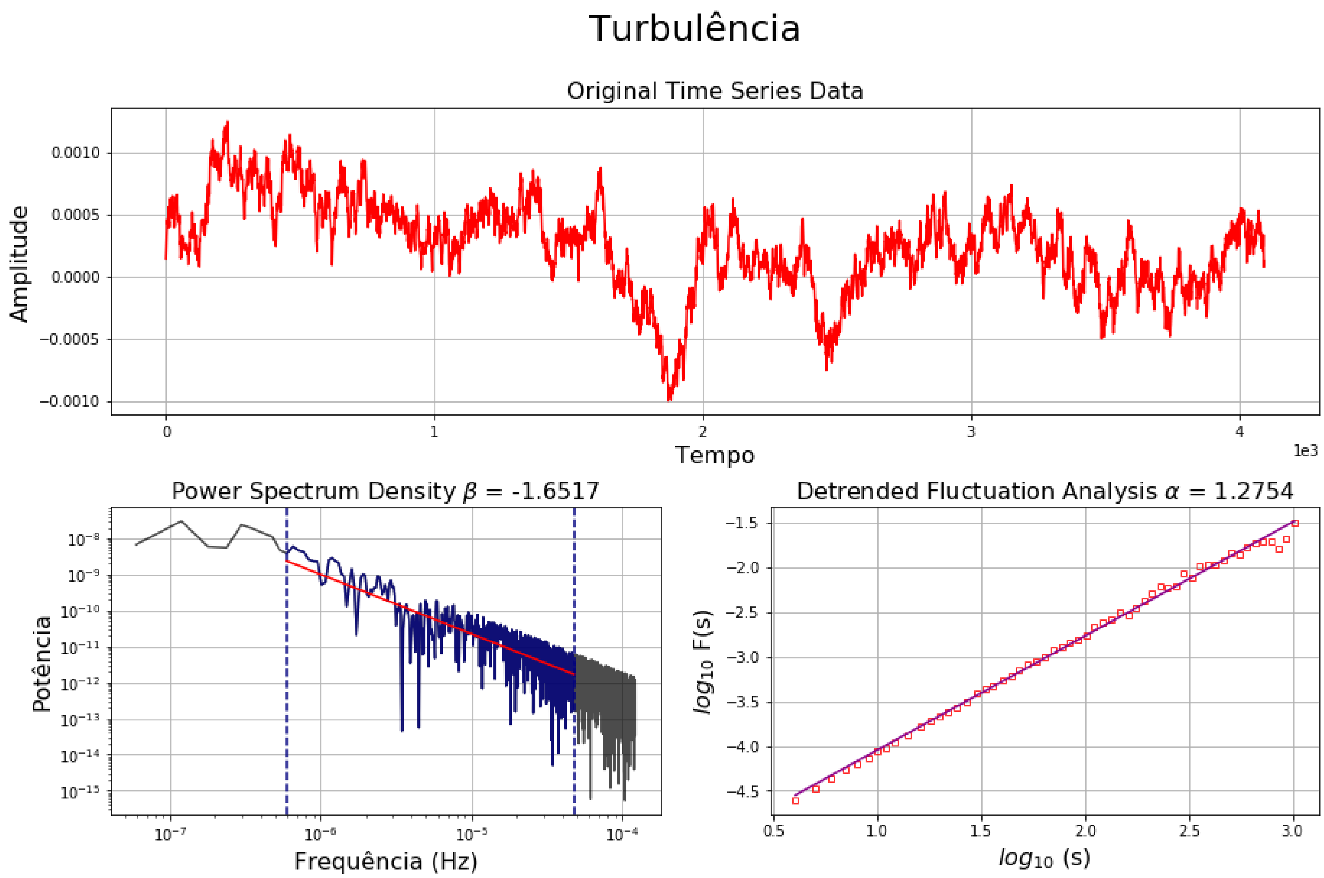
```
In [10]: aux.plot_estimated_autocorrelation(t, A, 0, len(A))
```



1.9 Plotando DFA e PSD

```
In [11]: aux.plot_psd_dfa(A, 'Turbulência')
```

```
Original time series data (4096 points):

First 10 points: [ 0.000143  0.000198  0.000291  0.000332  0.000385  0.000441  0.000422
  0.000472  0.000389  0.000461]


1. Plotting time series data...
2. Plotting Power Spectrum Density...
3. Plotting Detrended Fluctuation Analysis...
```



2 Analise dos primeiros 1024 pontos

```
In [12]: A = save_A[1024:]
         name = "A.ex:1.3.c"
         savetxt(name + ".txt", A)
```

2.1 Calculando os momentos do ensemble

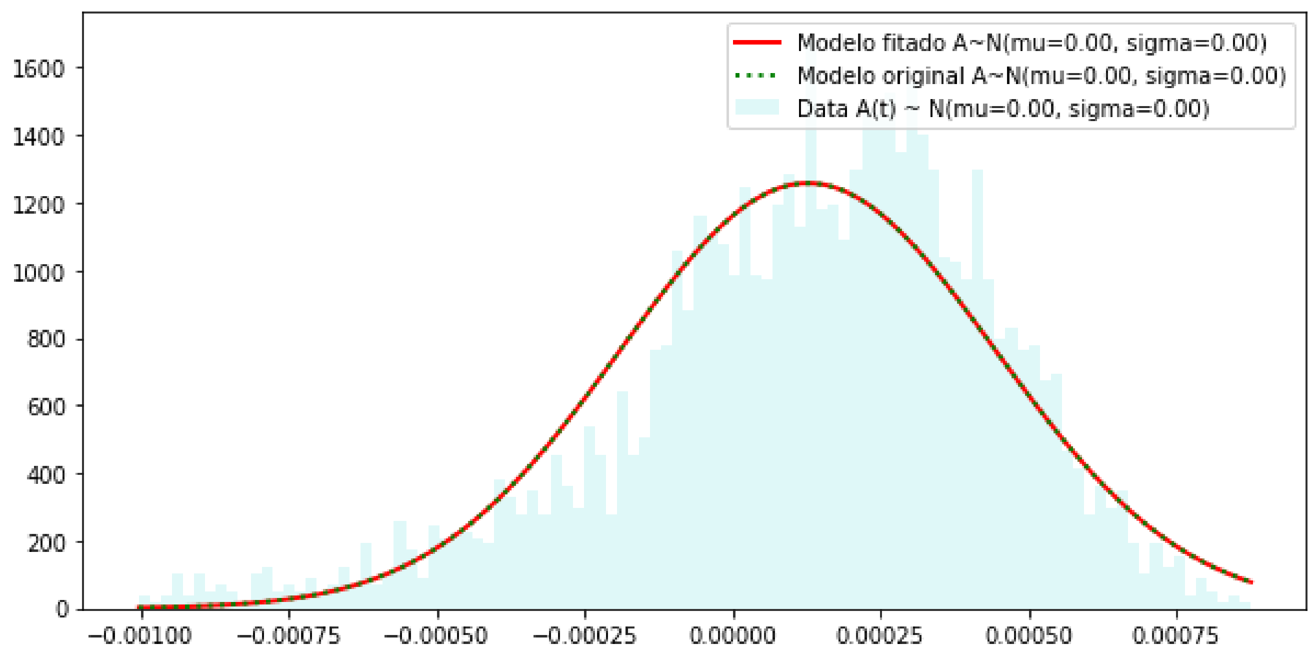
```
In [13]: A_mean, A_var, A_skew, A_kurtosis = aux.calcMoments(A)

         print("mean : ", A_mean)
         print("var  : ", A_var)
         print("skew : ", A_skew)
         print("kurt : ", A_kurtosis)
```

```
A_Q1 = scoreatpercentile(A, 25)
A_Q3 = scoreatpercentile(A, 75)

print("Q1    : ", A_Q1)
print("Q3    : ", A_Q3)
```

```
mean :  0.000127077148437
var  :  1.00571332915e-07
skew :  -0.702454863501
kurt :  0.619430692274
Q1   :  -5e-05
Q3   :  0.000346
```

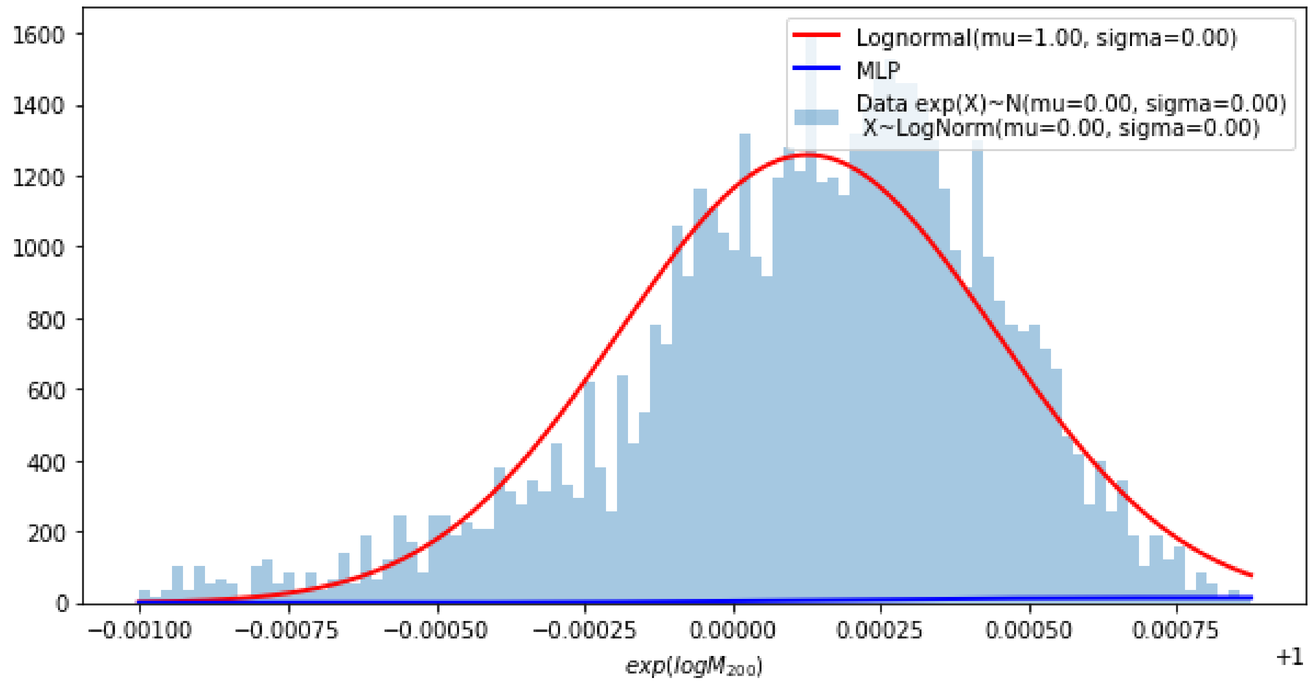
2.2 Fitando uma distribuição normal

In [14]: `aux.fitting_normal_distribution(A)`



2.3 Fitando uma distribuição lognormal

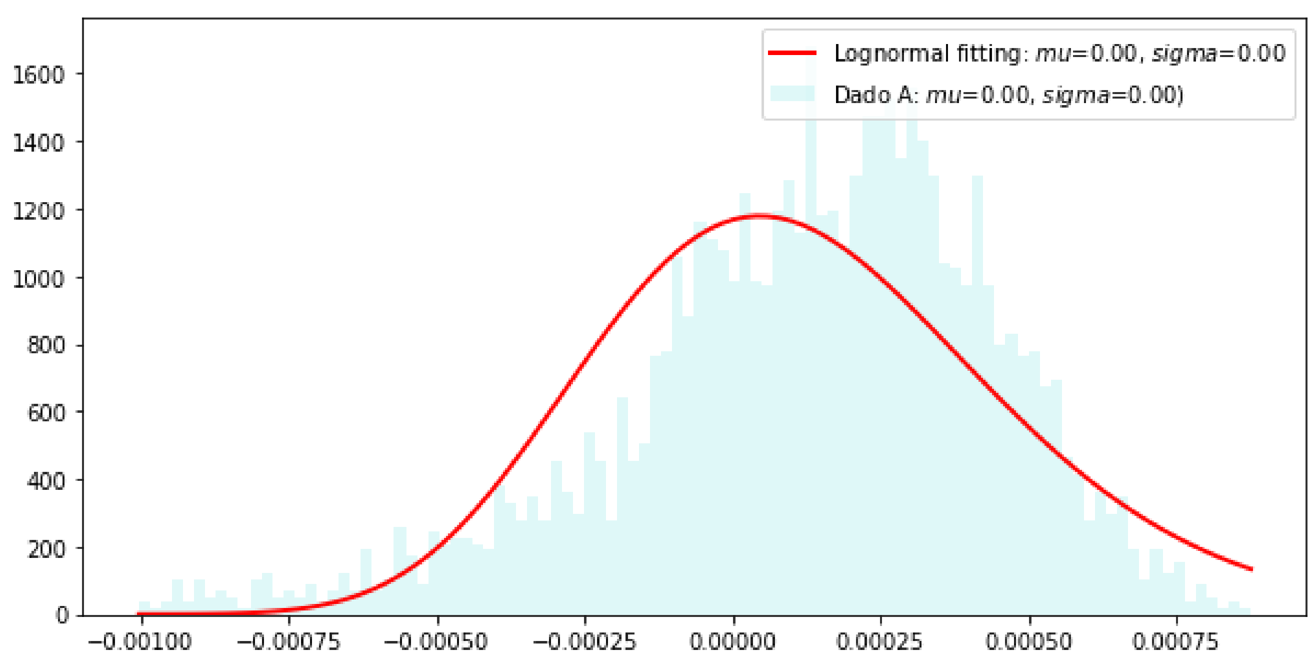
In [15]: `aux.fitting_lognormal_and_mlp_distribution(A)`



2.4 Fitando uma distribuição lognormal (utlizando minha implementação)

```
In [16]: aux.fitting_lognormal_distribution(A)
```

```
parametros de fitting:  (0.16270669887174818, -0.0020079926443614502, 0.0021087125907060279)
        Fitado                         Original
mean :  0.00012881796873005693          0.000127077148437
var  :  1.2249102107191445e-07          1.00571332915e-07
skew :  0.49576252538649906          -0.7024548635007172
kurt :  0.4401437639517196          0.6194306922739092
```

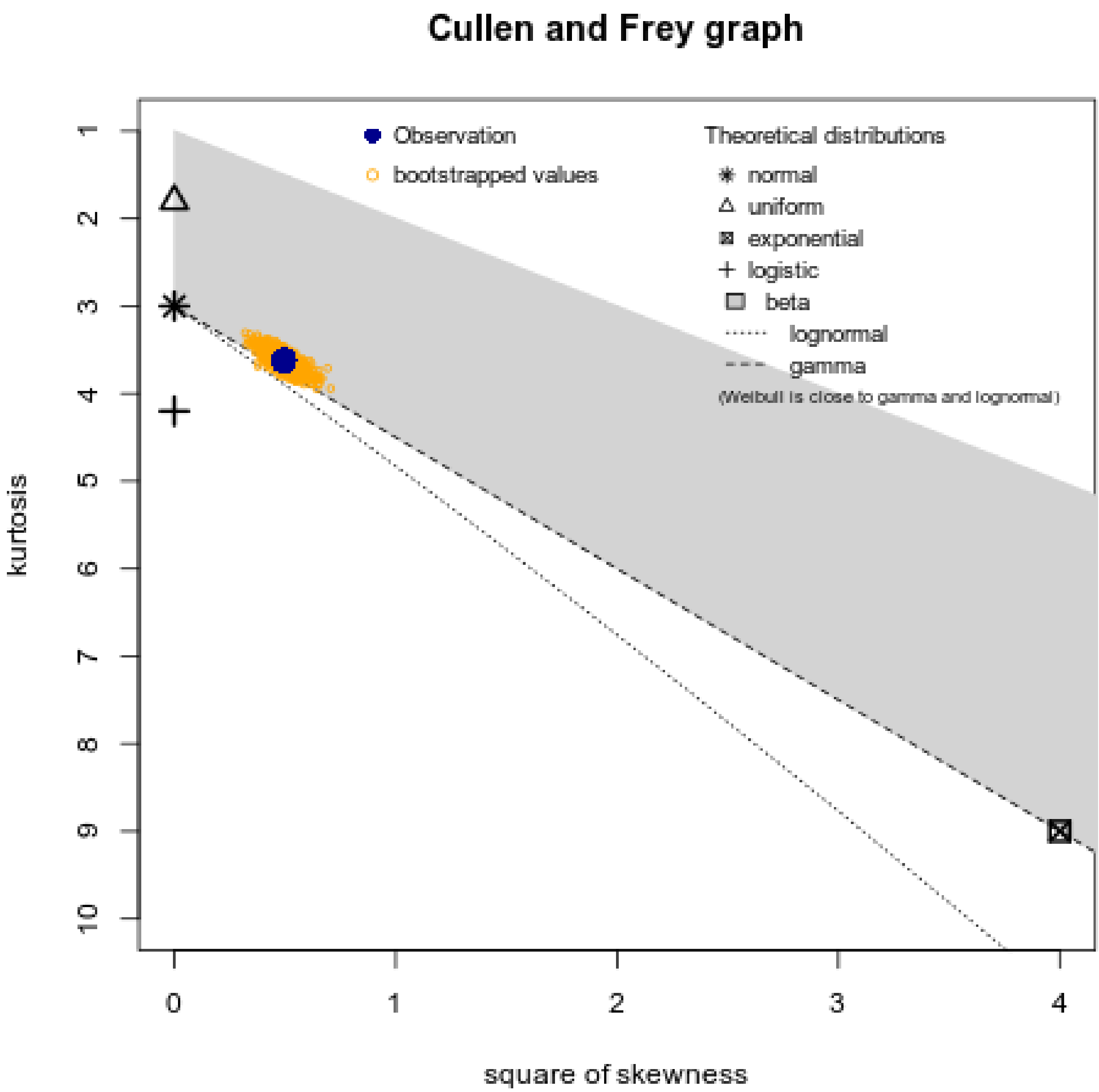


2.5 Plotando dados no espaço de Cullen-Frey

In [17]:
```
command = 'Rscript'
path_script = 'cullen_frey_script.R'

# define arguments
args = [name,]

# build subprocess command
cmd = [command, path_script] + args

x = subprocess.check_output(cmd, universal_newlines=True)
print(x)


Image(name+".png")
```

```
summary statistics
------
min:  -0.001003   max:  0.000875
median:  0.0001635
mean:  0.0001270771
estimated sd:  0.0003171815
estimated skewness:  -0.7027981
estimated kurtosis:  3.622396
```

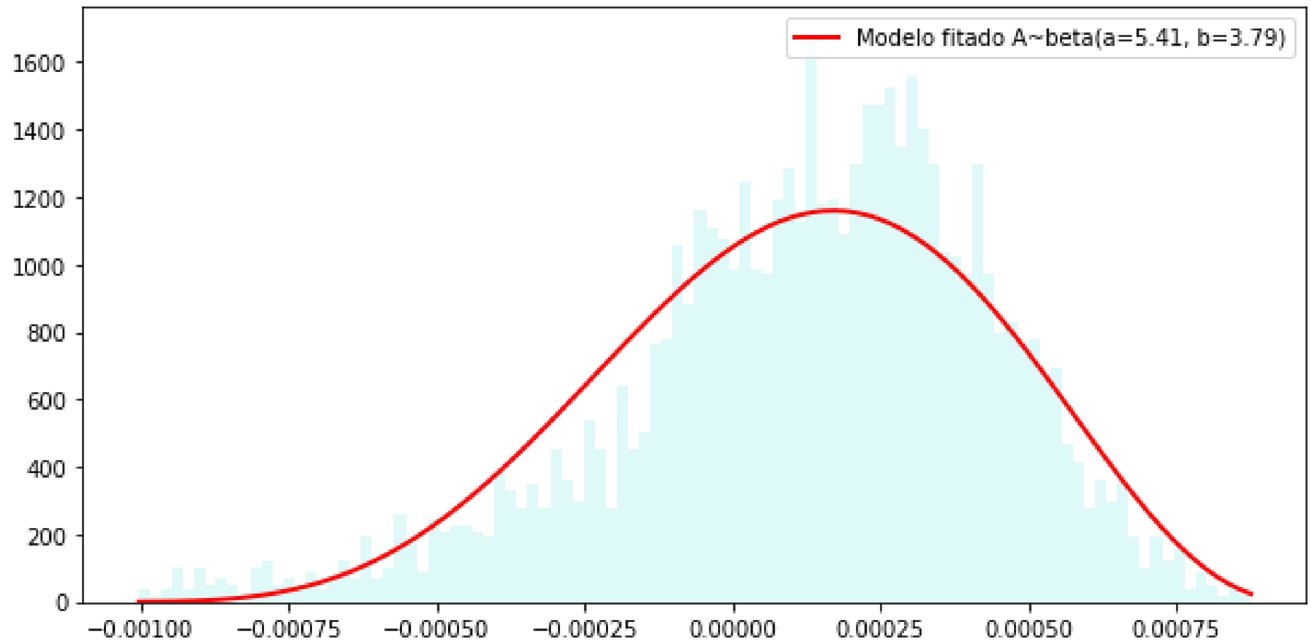
Out[17]:



2.6 Fitando melhor distribuição segundo método de Cullen-Frey

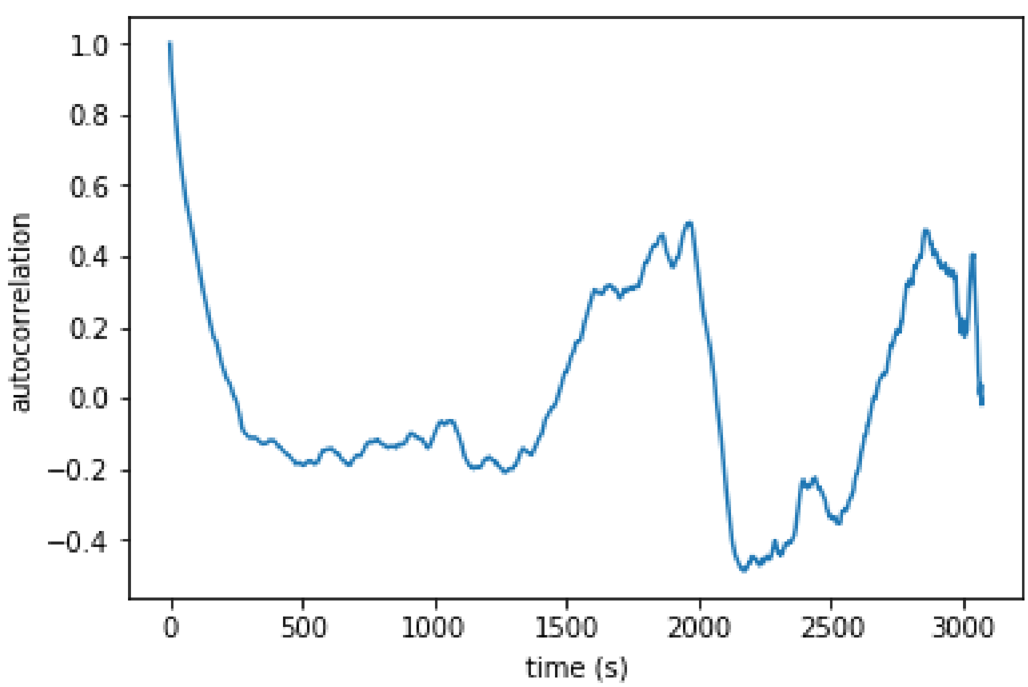
```
In [18]: aux.fitting_beta_distribution(A)
```

```
parametros de fitting:  (5.406530912226378, 3.7860328798645693, -0.001103, 0.002078)
        Fitado                         Original
mean :  0.00011915863710105883          0.000127077148437
var  :  1.0262127713803663e-07          1.00571332915e-07
skew :  -0.20433328103302115          -0.7024548635007172
kurt :  -0.4346116779535383         0.6194306922739092
```



2.7 Calculando autocorrelação

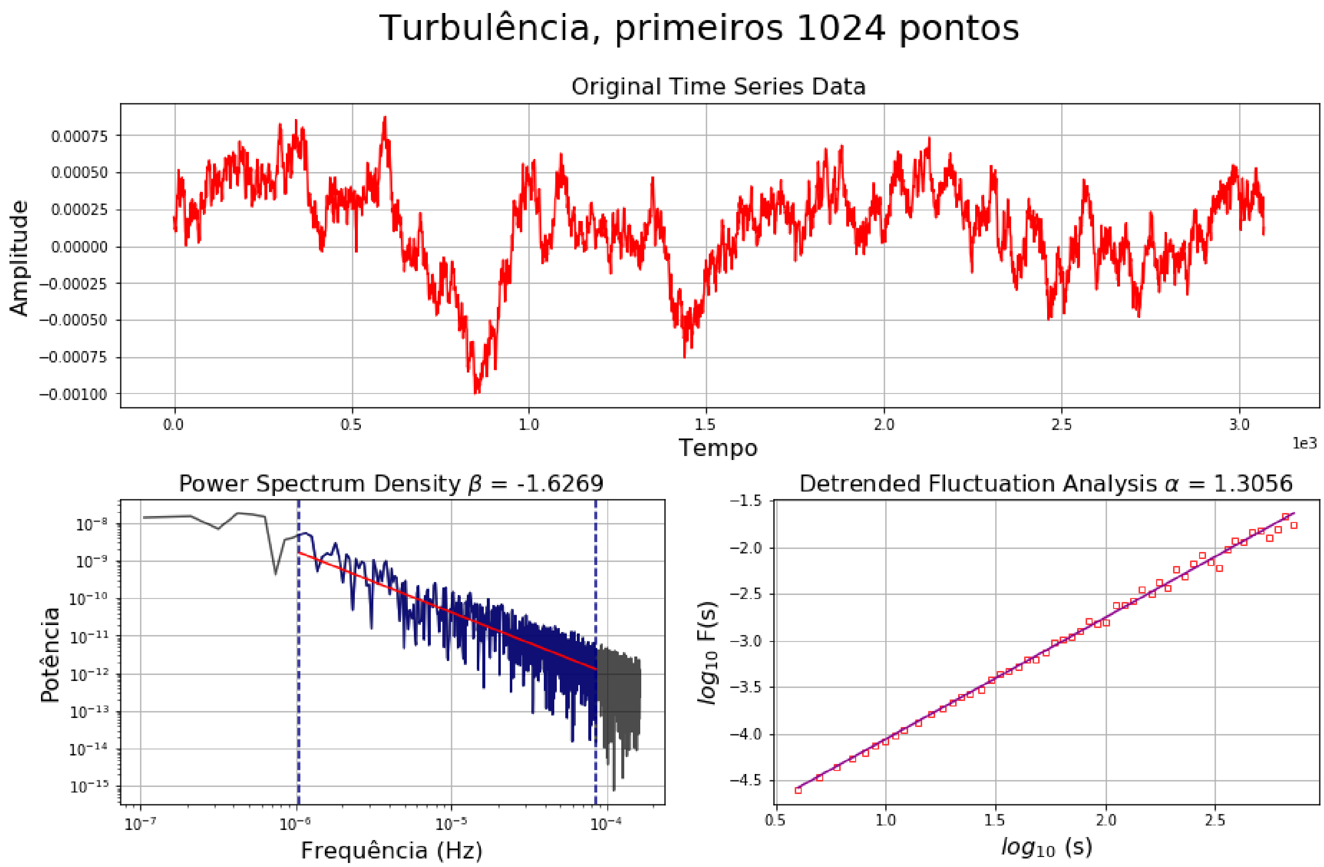
```
In [19]: aux.plot_estimated_autocorrelation(t, A, 0, len(A))
```



2.8 Plotando DFA e PSD

```
In [20]: aux.plot_psd_dfa(A, 'Turbulência, primeiros 1024 pontos')
```

```
Original time series data (3072 points):

First 10 points: [  1.95000000e-04   1.72000000e-04   1.46000000e-04   1.11000000e-04
   1.26000000e-04   9.50000000e-05   1.77000000e-04   1.90000000e-04
   2.87000000e-04   3.41000000e-04]


1. Plotting time series data...
2. Plotting Power Spectrum Density...
3. Plotting Detrended Fluctuation Analysis...
```



3 Analise dos últimos 1024 pontos

- Section ??
- Section ??
- Section ??
- Section ??
- Section ??
- Section ??
- Section ??

```
In [21]: A = save_A[3*1024:4096]
         name = "A.ex:1.3.c"
         savetxt(name + ".txt", A)

In [22]: A.shape
```

```
Out[22]: (1024,)
```

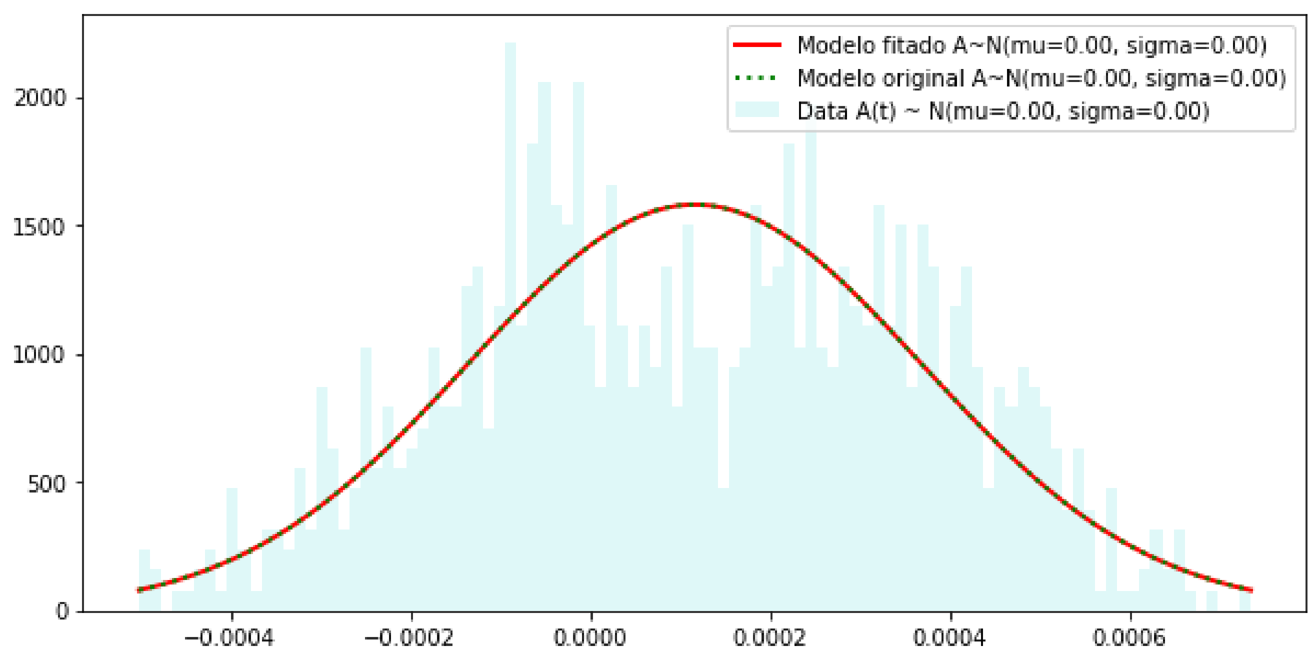
3.1 Calculando os momentos do ensemble

```
In [23]: A_mean, A_var, A_skew, A_kurtosis = aux.calcMoments(A)

         print("mean : ", A_mean)
         print("var  : ", A_var)
         print("skew : ", A_skew)
         print("kurt : ", A_kurtosis)

         A_Q1 = scoreatpercentile(A, 25)
         A_Q3 = scoreatpercentile(A, 75)

         print("Q1   : ", A_Q1)
         print("Q3   : ", A_Q3)
```

```
mean :  0.00011609375
var  :  6.37344697266e-08
skew :  -0.0478410720291
kurt :  -0.771149471011
Q1   :  -7.225e-05
Q3   :  0.00031825
```

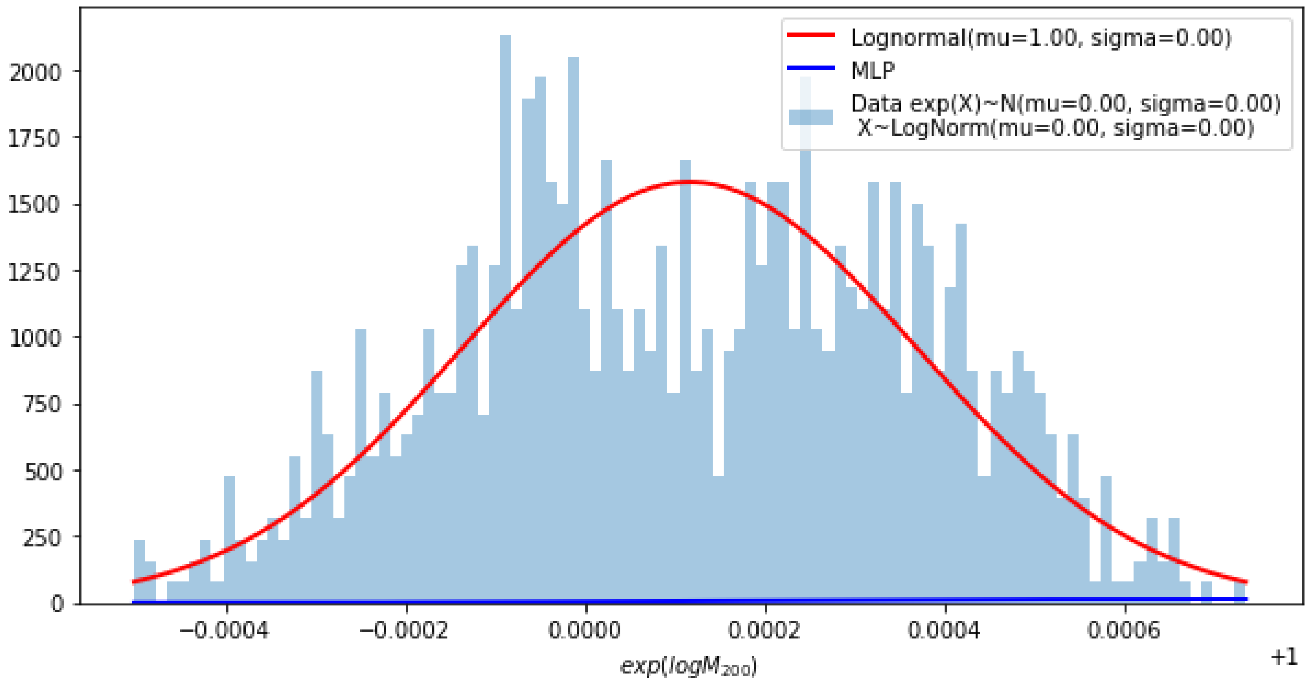
3.2 Fitando uma distribuição normal

```
In [24]: aux.fitting_normal_distribution(A)
```



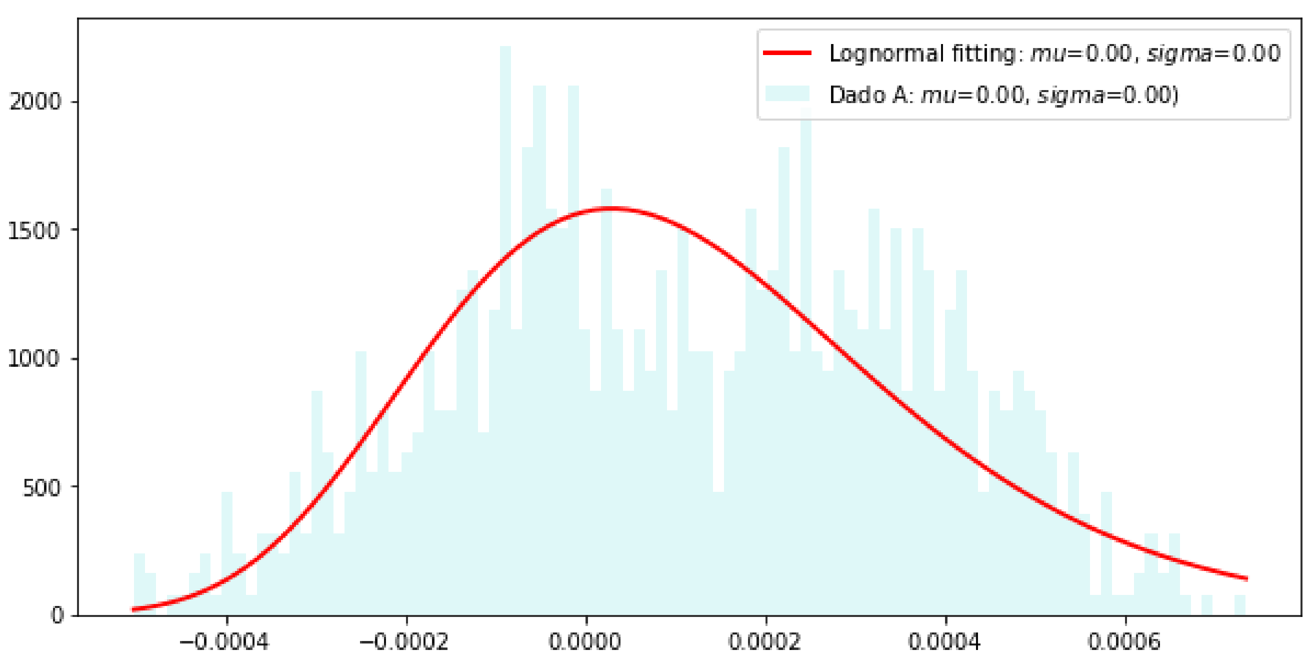
3.3 Fitando uma distribuição lognormal

```
In [25]: aux.fitting_lognormal_and_mlp_distribution(A)
```



3.4 Fitando uma distribuição lognormal (utlizando minha implementação)

```
In [26]: aux.fitting_lognormal_distribution(A)

parametros de fitting:  (0.22860915602339449, -0.0010473623536452269, 0.0011346407050944821)
        Fitado                          Original
mean :  0.00011731851213566693           0.00011609375
var  :  7.277783411656646e-08           6.37344697266e-08
skew :  0.7073138359009346           -0.04784107202911915
kurt :  0.9025435153637078           -0.7711494710107498
```

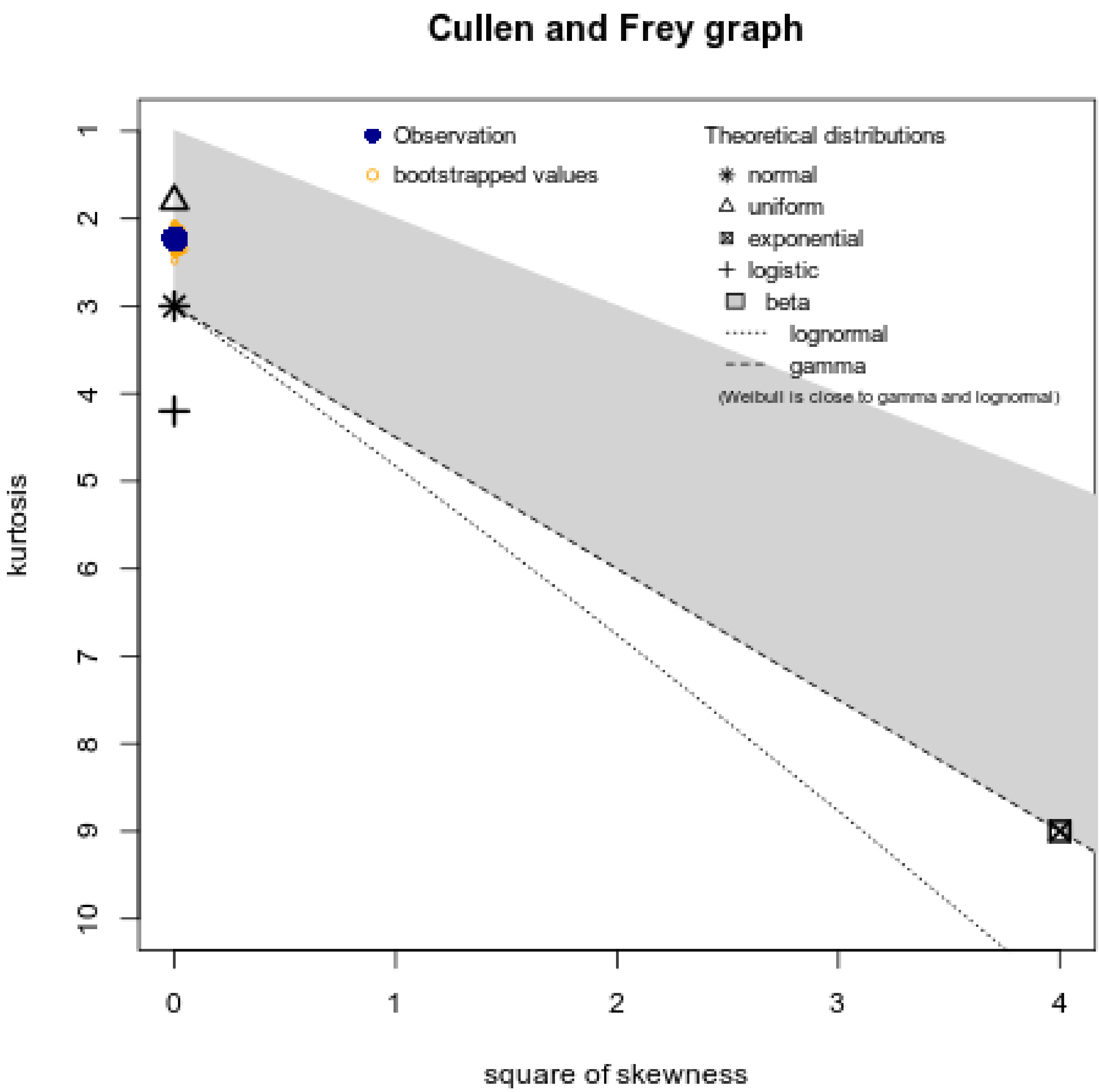


3.5 Plotando dados no espaço de Cullen-Frey

In [27]:
```
command = 'Rscript'
path_script = 'cullen_frey_script.R'

# define arguments
args = [name,]

# build subprocess command
cmd = [command, path_script] + args

x = subprocess.check_output(cmd, universal_newlines=True)
print(x)


Image(name+".png")
```

```
summary statistics
------
min:  -0.000502   max:  0.000734
median:  0.000111
mean:  0.0001160937
estimated sd:  0.0002525802
estimated skewness:  -0.04791128
estimated kurtosis:  2.230954
```

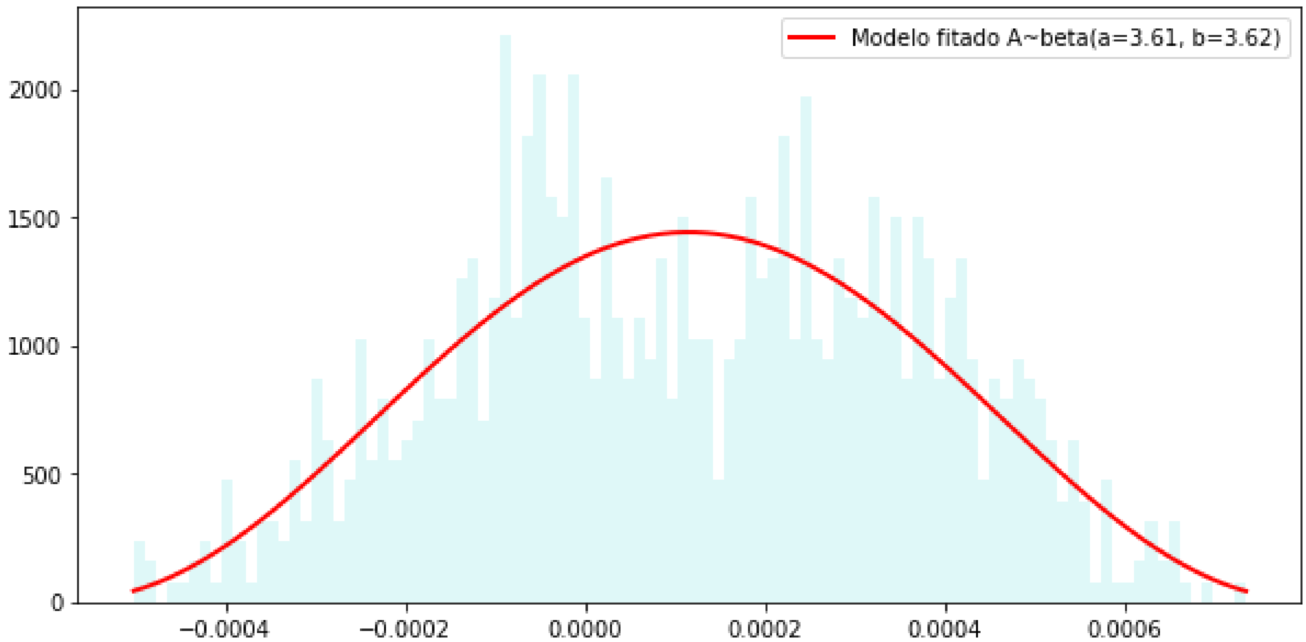
Out[27]:



3.6 Fitando melhor distribuição segundo método de Cullen-Frey

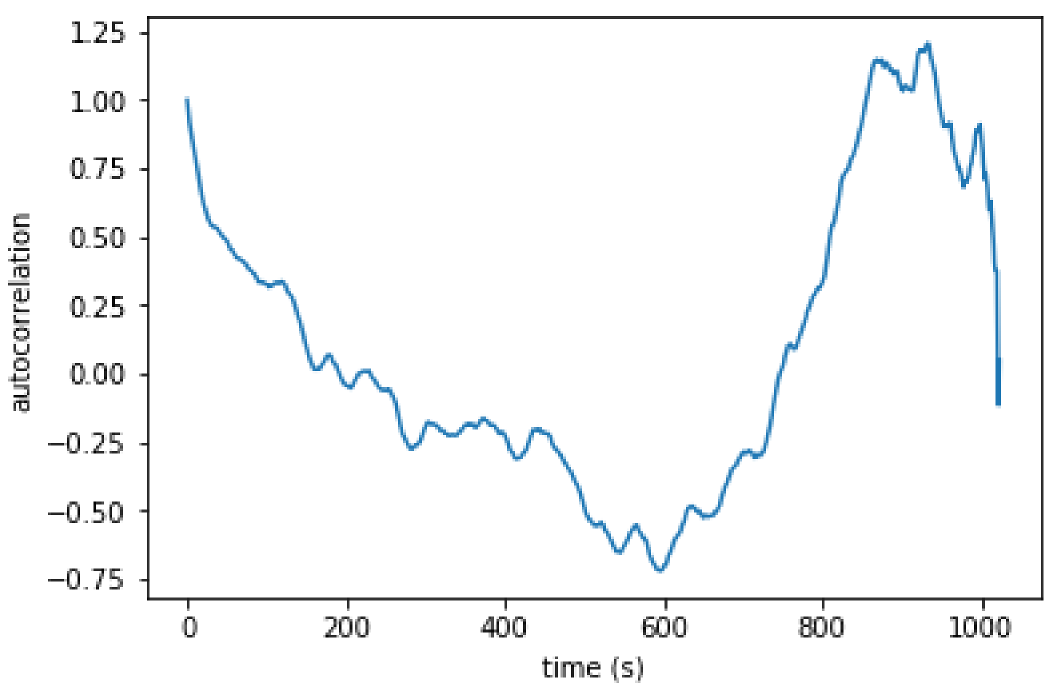
```
In [28]: aux.fitting_beta_distribution(A)
```

```
parametros de fitting:  (3.6059826185689086, 3.615293426803603, -0.000602, 0.001436)
        Fitado                         Original
mean :  0.00011507424113542993          0.00011609375
var  :  6.270597655709369e-08          6.37344697266e-08
skew :  0.0016036603060277039          -0.04784107202911915
kurt :  -0.5870073757393641          -0.7711494710107498
```



3.7 Calculando autocorrelação

```
In [29]: aux.plot_estimated_autocorrelation(t, A, 0, len(A))
```



3.8 Plotando DFA e PSD

```
In [30]: aux.plot_psd_dfa(A, 'Turbulência, últimos 1024 pontos')
```

```
Original time series data (1024 points):

First 10 points: [ 0.00051   0.000409  0.000346  0.000406  0.000513  0.000442  0.000438
  0.000446  0.000375  0.000375]


1. Plotting time series data...
2. Plotting Power Spectrum Density...
3. Plotting Detrended Fluctuation Analysis...
```