Equação Logística $\rho = 3.75$, $A_0 = 0.0001$

27 de maio de 2018

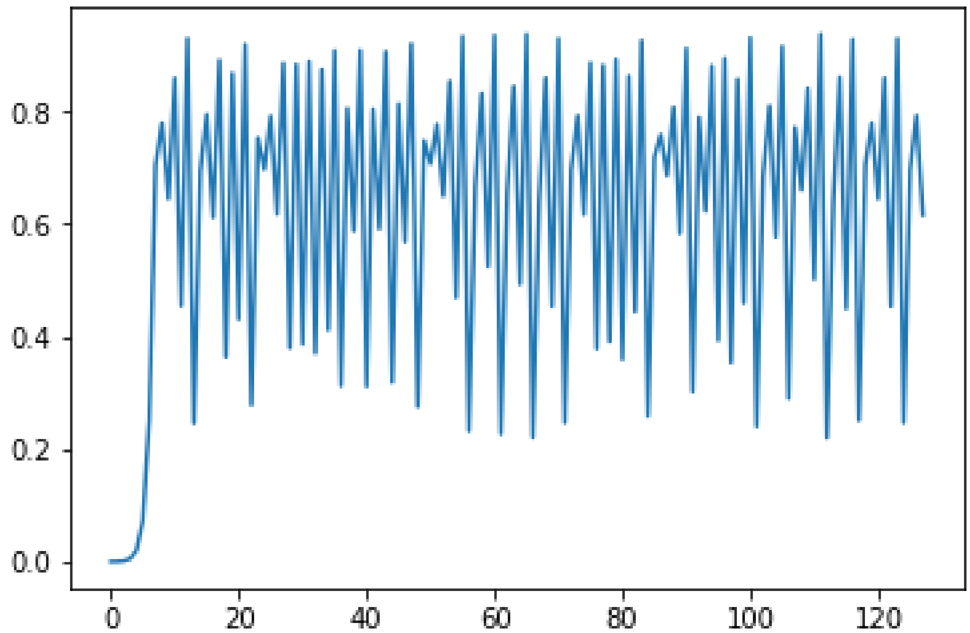
In [1]:
```
from scipy.stats import moment
from scipy.stats import kurtosis, skew, scoreatpercentile
from scipy.stats import norm, lognorm, beta
from scipy.optimize import minimize

from numpy import zeros, fromiter, savetxt
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:1.1.a"

rho = 3.75

A = zeros(size)
A[0] = 0.0001

for i in range(0, size-1):
    A[i+1] = rho*A[i]*(1-A[i])

savetxt(name + ".txt", A)

save_A = A
```

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



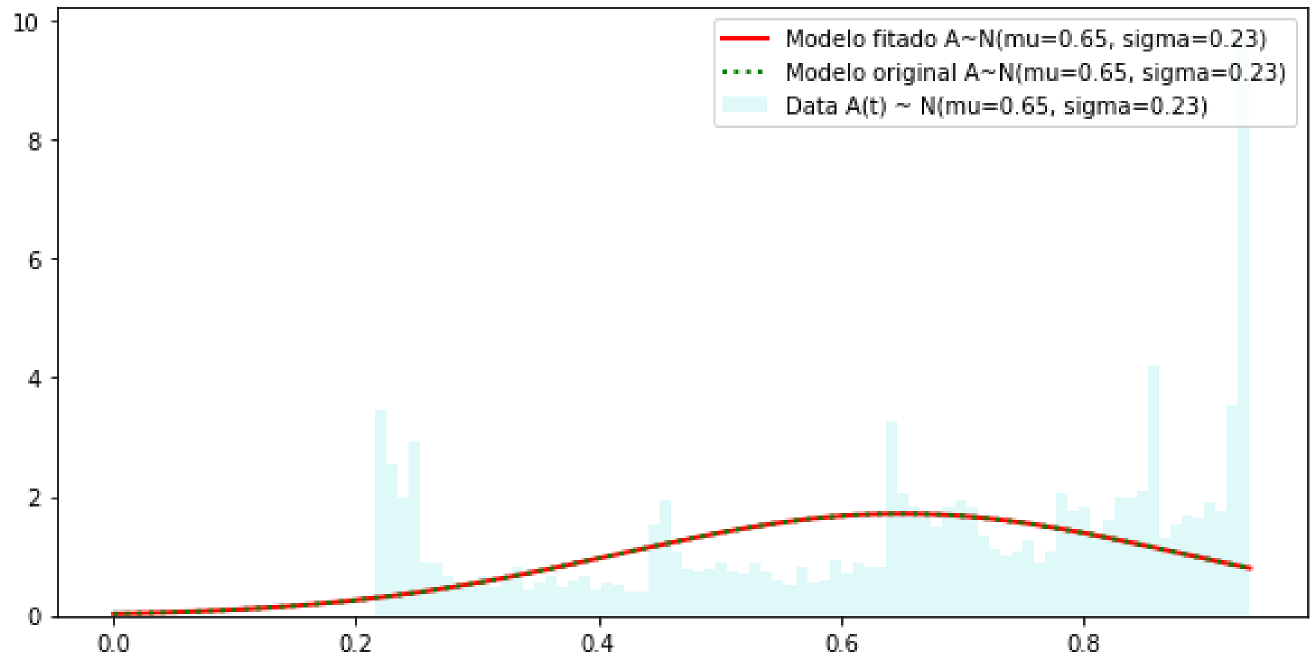
1.2 Calculando os momentos do ensemble

```
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 :  0.649942118587
var  :  0.0541387057068
skew :  -0.532938610347
kurt :  -0.975894876415
Q1   :  0.461804766442
Q3   :  0.85520603739
```

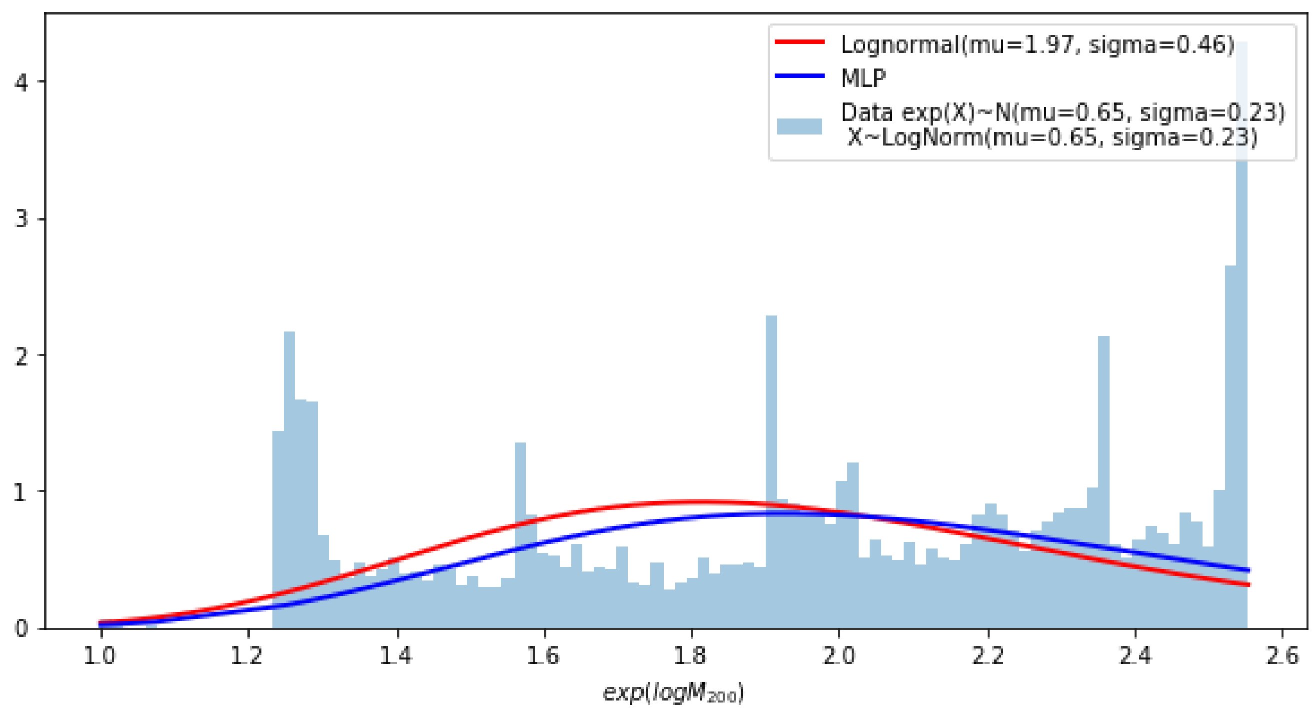
1.3 Fitando uma distribuição normal

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



1.4 Fitando uma distribuição lognormal

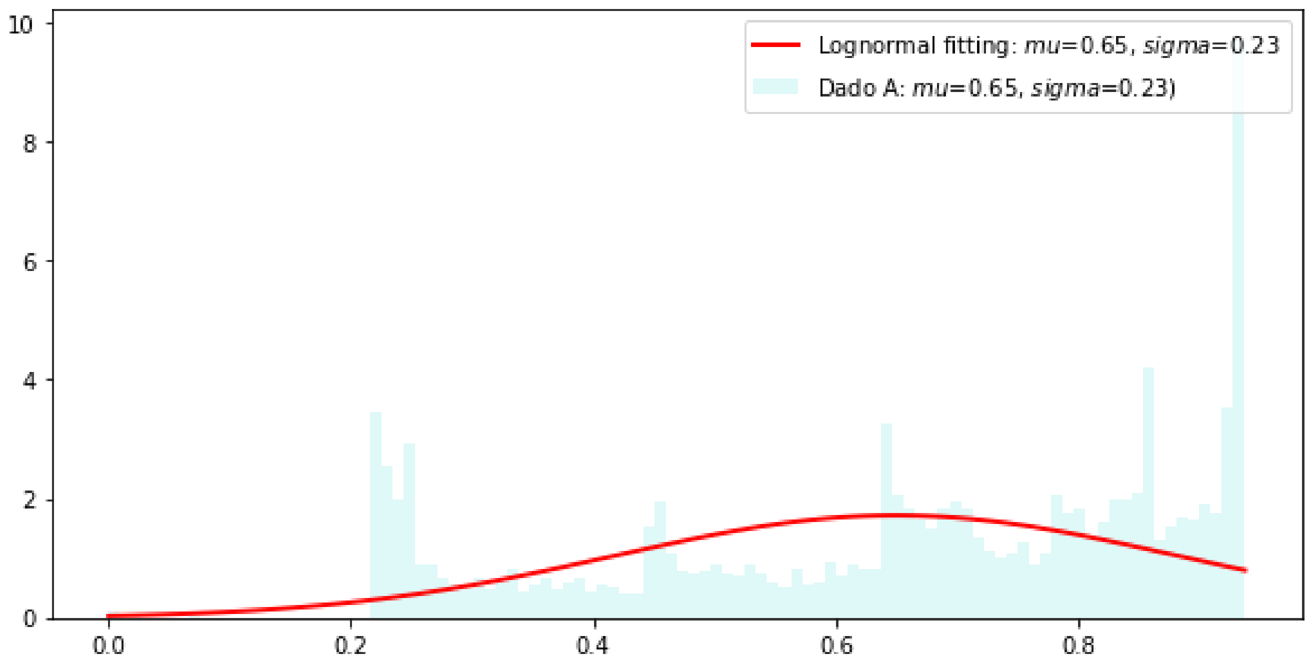
```
In [6]: aux.fitting_lognormal_and_mlp_distribution(A)
```



1.4.1 Fitando uma distribuição lognormal (utlizando minha implementação)

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

```
parametros de fitting:  (0.0028987501553373787, -79.35504533233734, 80.005368368211975)
        Fitado                         Original
mean :  0.6506591692338048          0.649942118587
var  :  0.053785511372061605          0.0541387057068
skew :  0.008696293091770939          -0.5329386103474337
kurt :  0.00013444566336584533         -0.9758948764152438
```

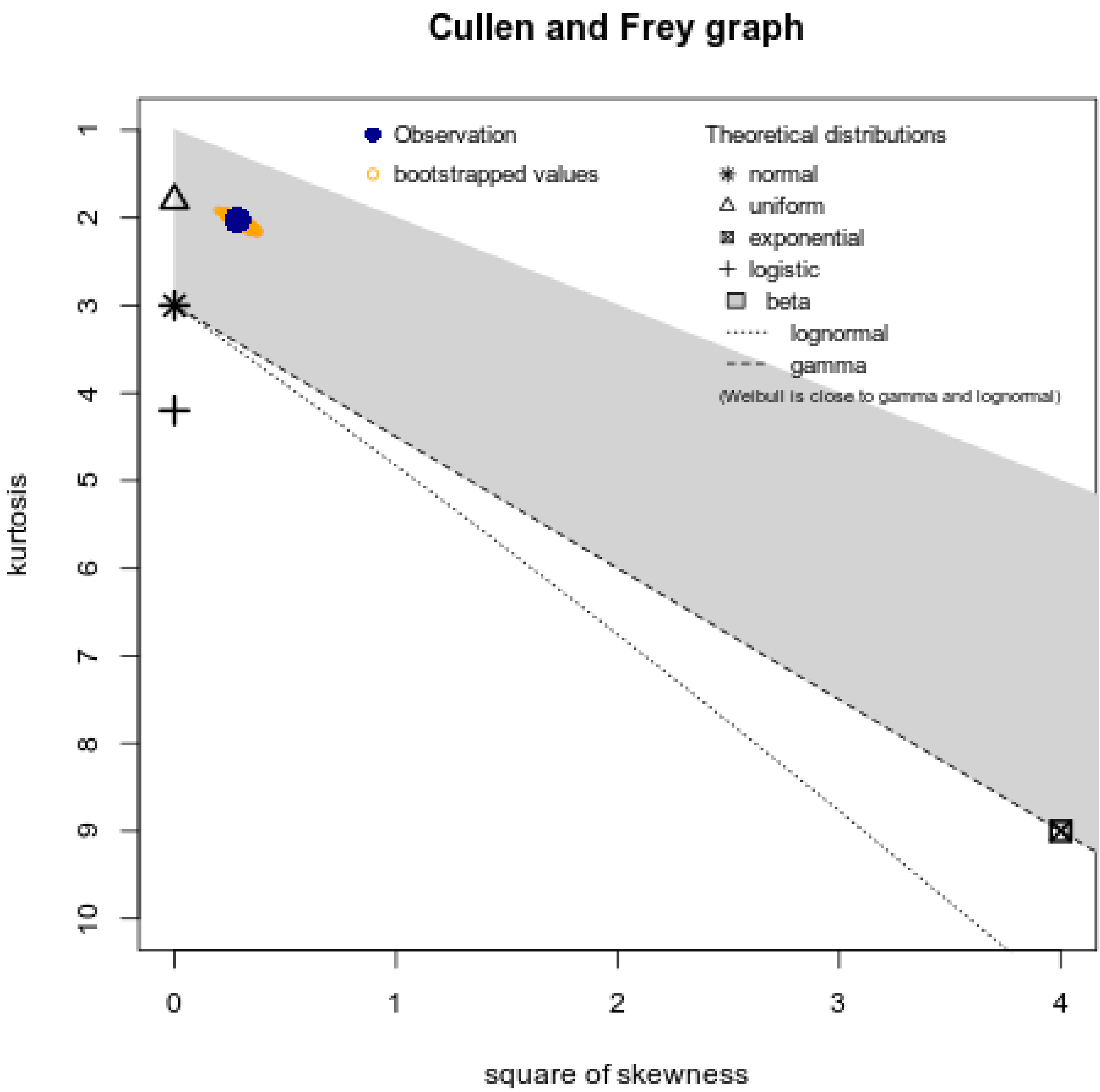


1.5 Plotando dados no espaço de Cullen-Frey

In [8]:
```python
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:  1e-04   max:  0.9375
median:  0.6949414
mean:  0.6499421
estimated sd:  0.2327057
estimated skewness:  -0.5331339
estimated kurtosis:  2.024379
```

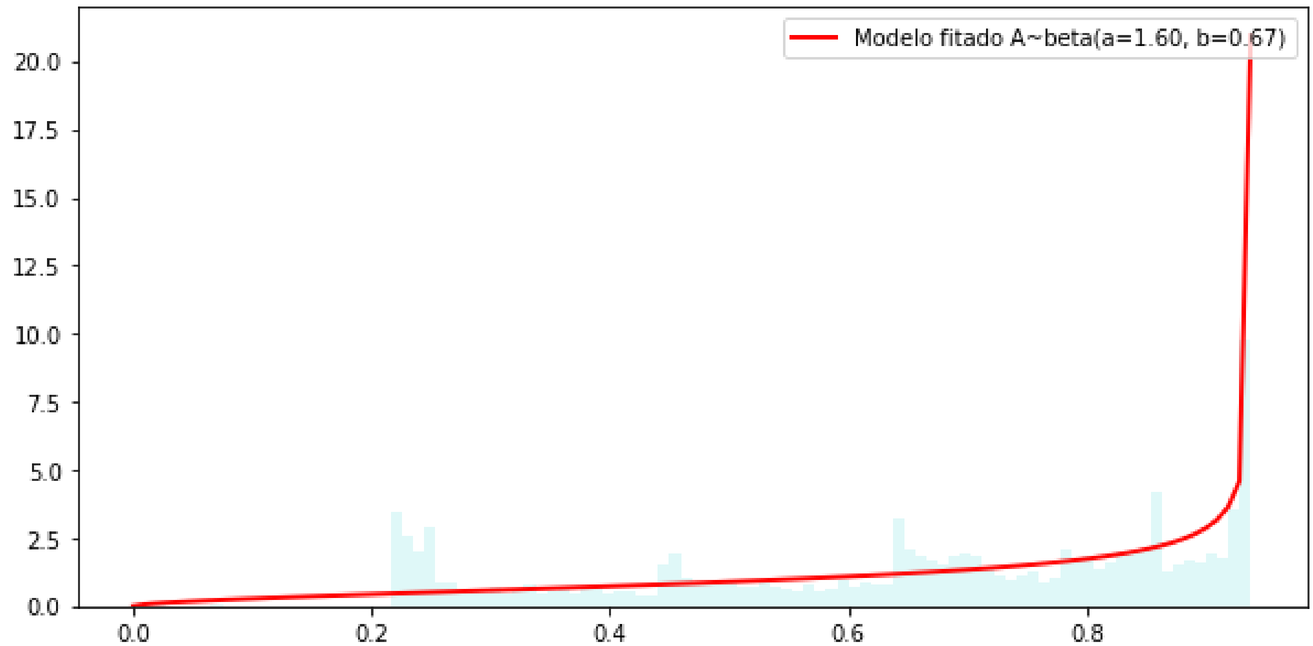
Out[8]:



1.6 Fitando melhor distribuição segundo método de Cullen-Frey

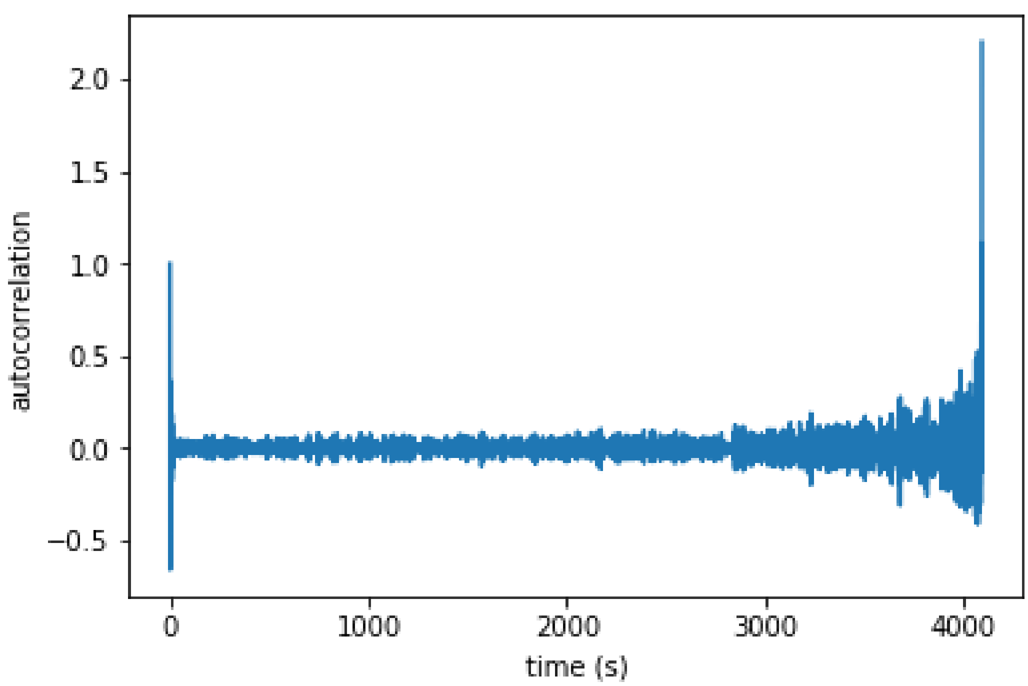
In [9]: `aux.fitting_beta_distribution(A)`

```
parametros de fitting:  (1.5958709801722486, 0.66841430113382549, 0.0, 0.93759999414477568)
        Fitado                         Original
mean :  0.6608215996538368          0.649942118587
var  :  0.056030991667475306          0.0541387057068
skew :  -0.7609387058229865          -0.5329386103474337
kurt :  -0.4362018469271502          -0.9758948764152438
```



1.7 Calculando autocorrelação

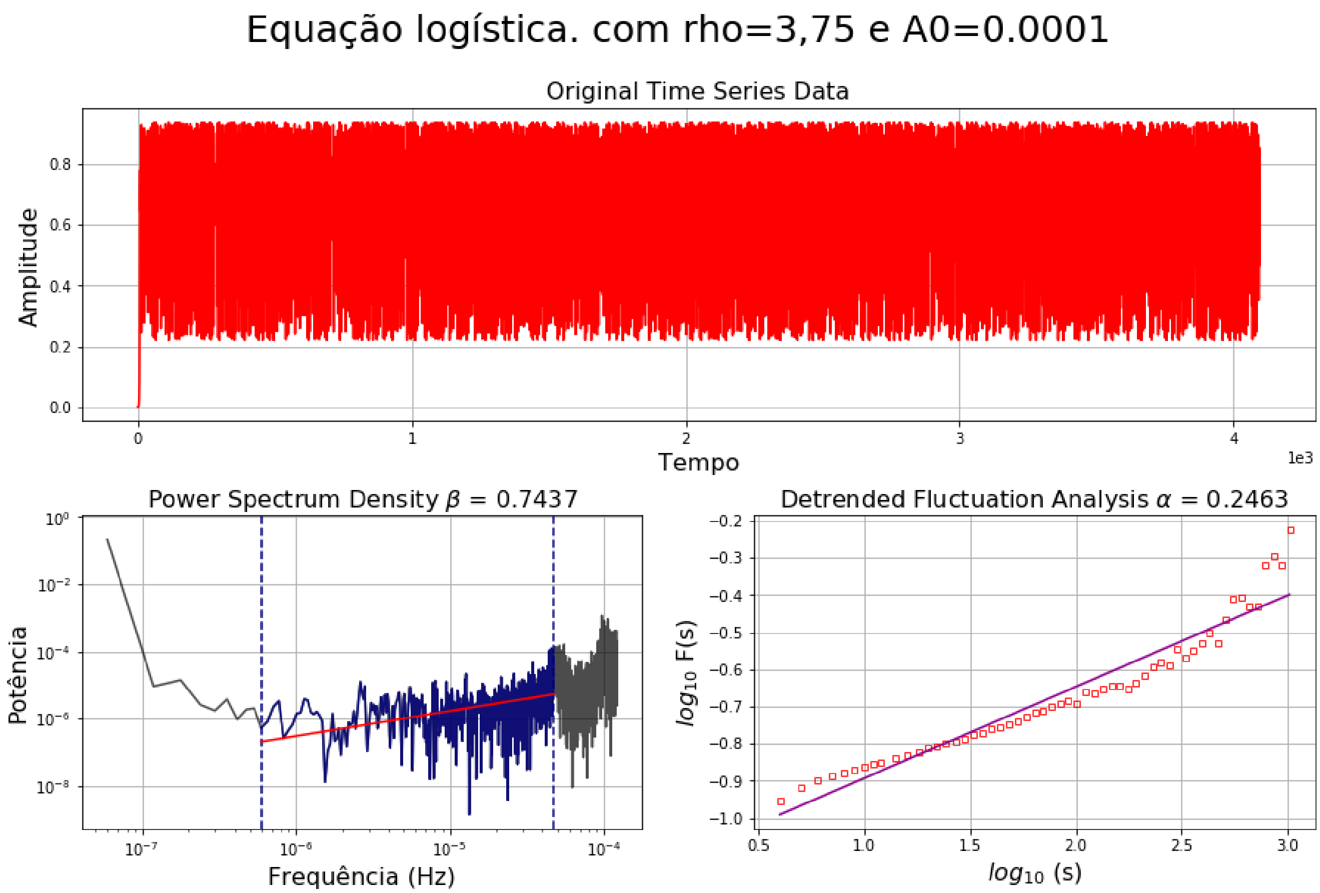
```
In [10]: aux.plot_estimated_autocorrelation(t, A, 0, len(A))
```



1.8 Plotando DFA e PSD

```
In [11]: aux.plot_psd_dfa(A, 'Equação logística. com rho=3,75 e A0=0.0001')
```

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

First 10 points: [  1.00000000e-04   3.74962500e-04   1.40558214e-03   5.26352428e-03
   1.96343235e-02   7.21830631e-02   2.51147507e-01   7.05271637e-01
   7.79488331e-01   6.44573524e-01]


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:1.1.a"
         savetxt(name + ".txt", A)
```

2.1 Calculando os momentos do ensemble

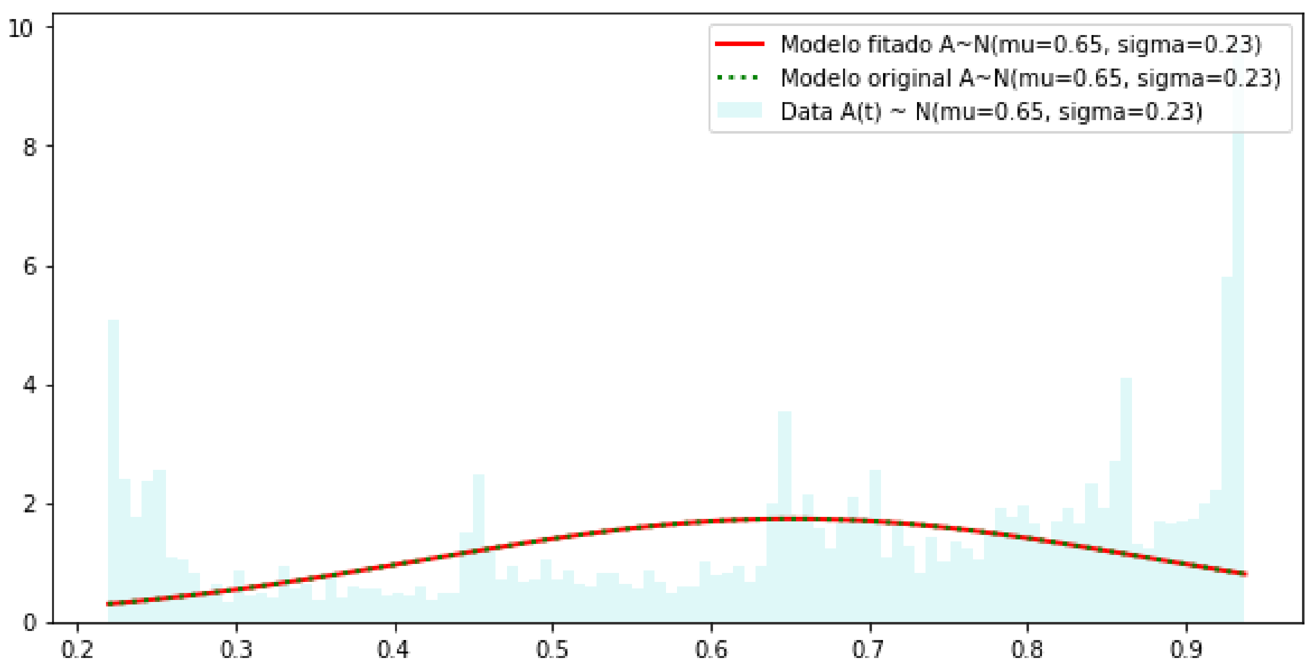
```
In [13]: A_mean, A_var, A_skew, A_kurtosis = aux.calcMoments(A)

         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 :  0.651618001356
var  :  0.0531894154818
skew :  -0.533838805535
kurt :  -0.98857228267
Q1   :  0.465820822002
Q3   :  0.854554556541
```

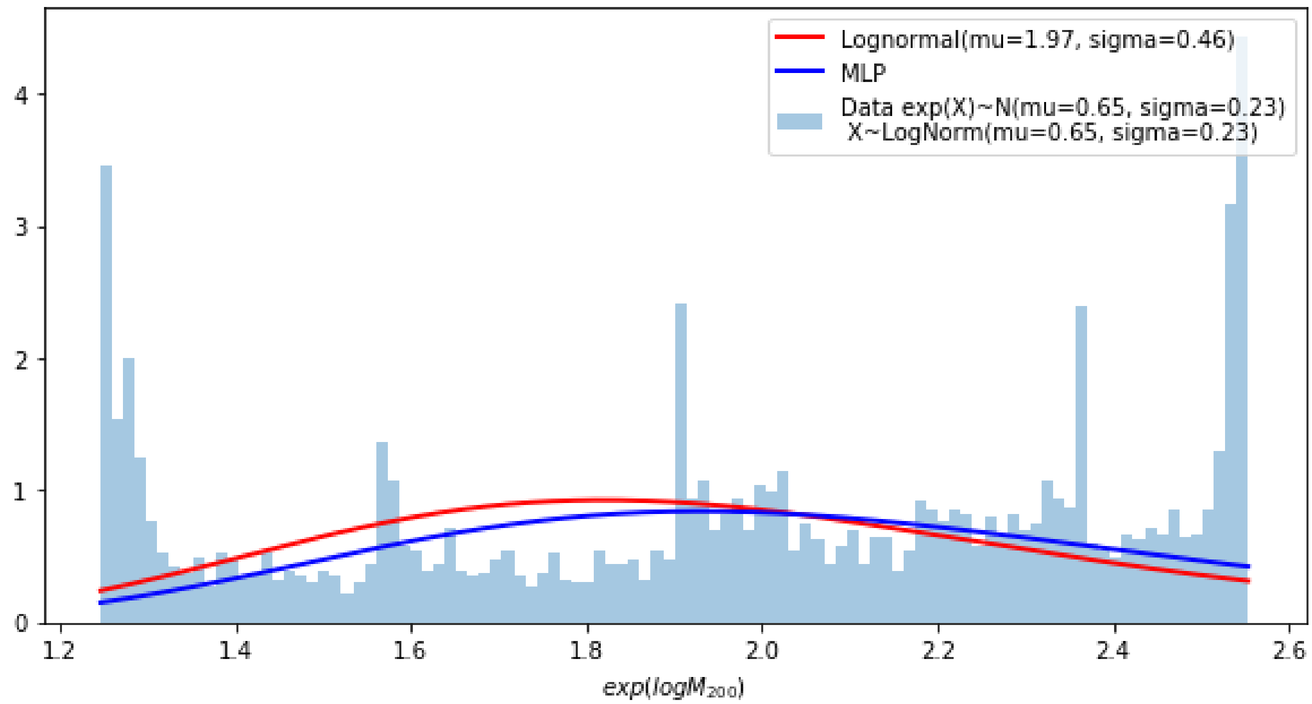
2.2 Fitando uma distribuição normal

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



2.3 Fitando uma distribuição lognormal

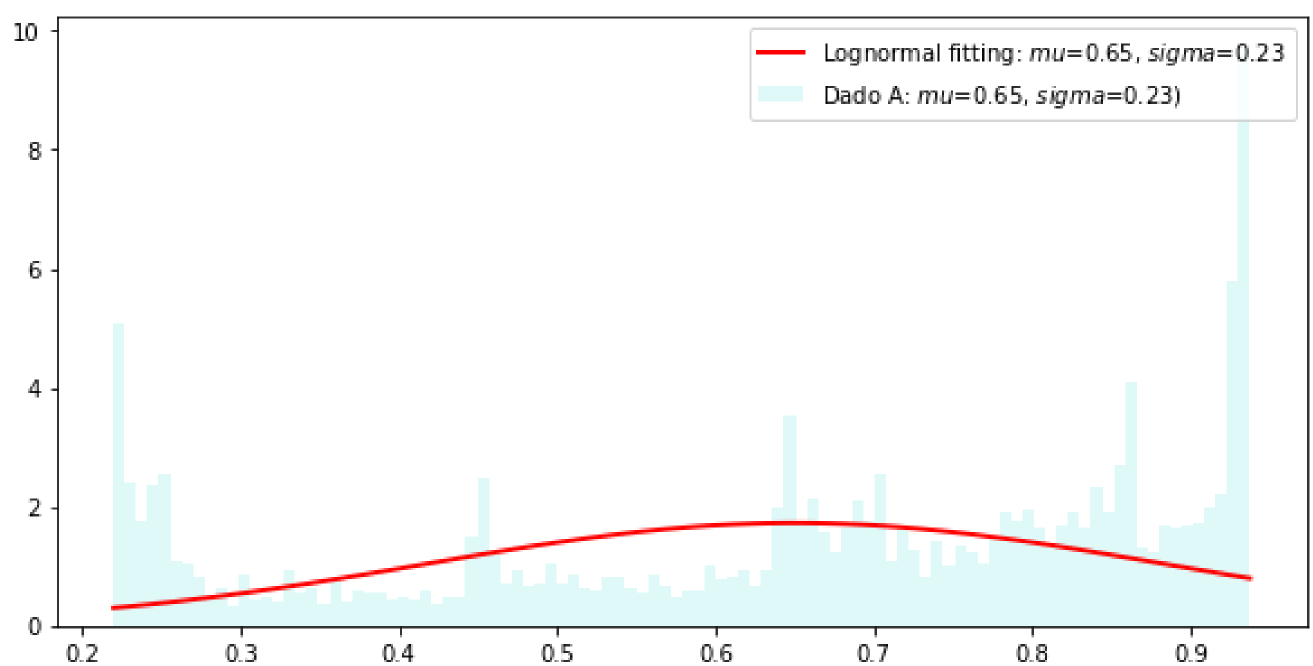
```
In [15]: aux.fitting_lognormal_and_mlp_distribution(A)
```



2.3.1 Fitando uma distribuição lognormal (utlizando minha implementação)

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

```
parametros de fitting:  (0.0037565315894072526, -60.778435421663545, 61.429250192598147)
        Fitado                         Original
mean :  0.6512482028043536          0.651618001356
var  :  0.05325172885764862          0.0531894154818
skew :  0.011269687537115226          -0.5338388055354238
kurt :  0.00022578905349401888          -0.9885722826698675
```

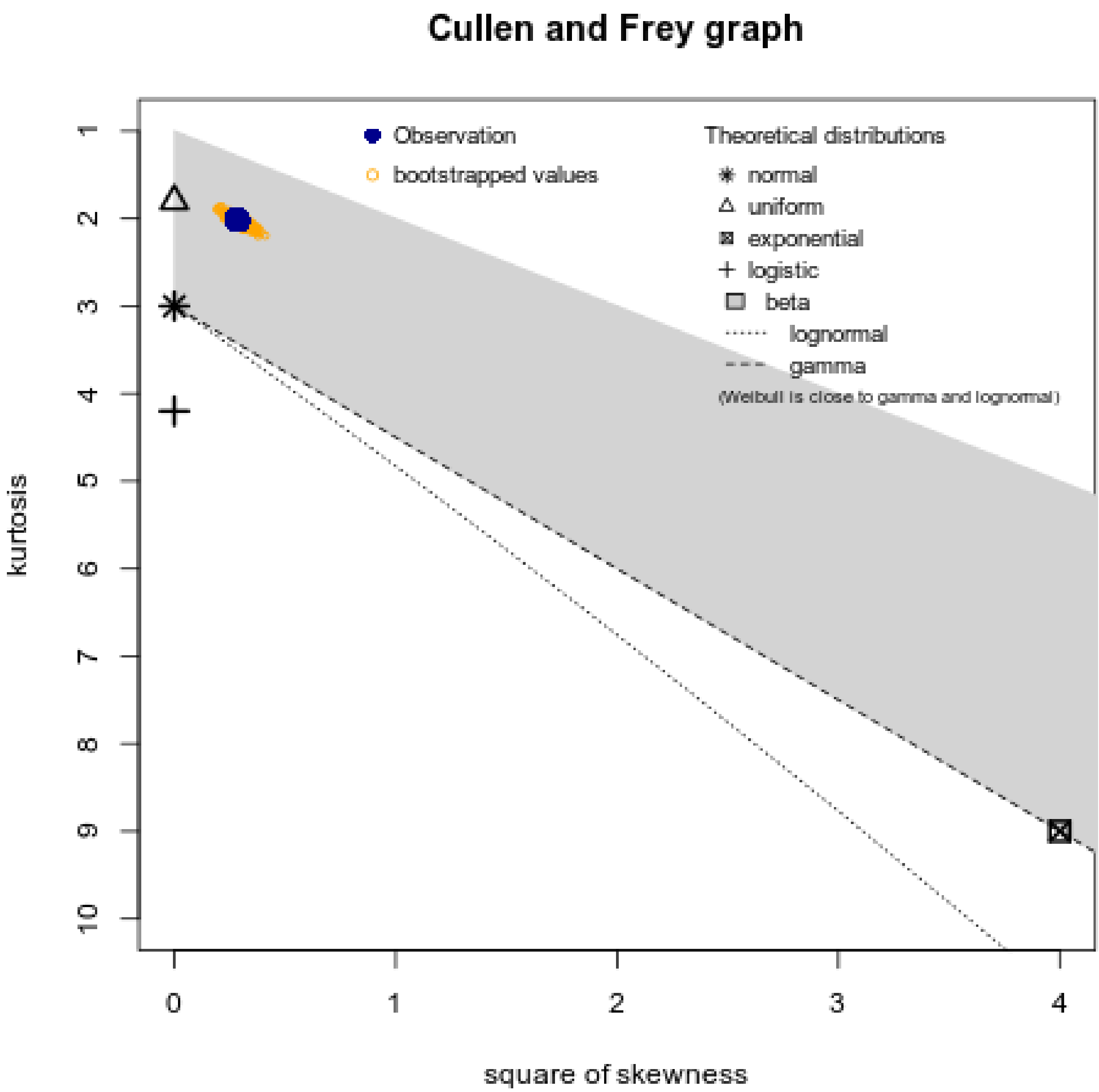


2.4 Plotando dados no espaço de Cullen-Frey

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:  0.2197266   max:  0.9375
median:  0.6966111
mean:  0.651618
estimated sd:  0.2306659
estimated skewness:  -0.5340996
estimated kurtosis:  2.011772
```

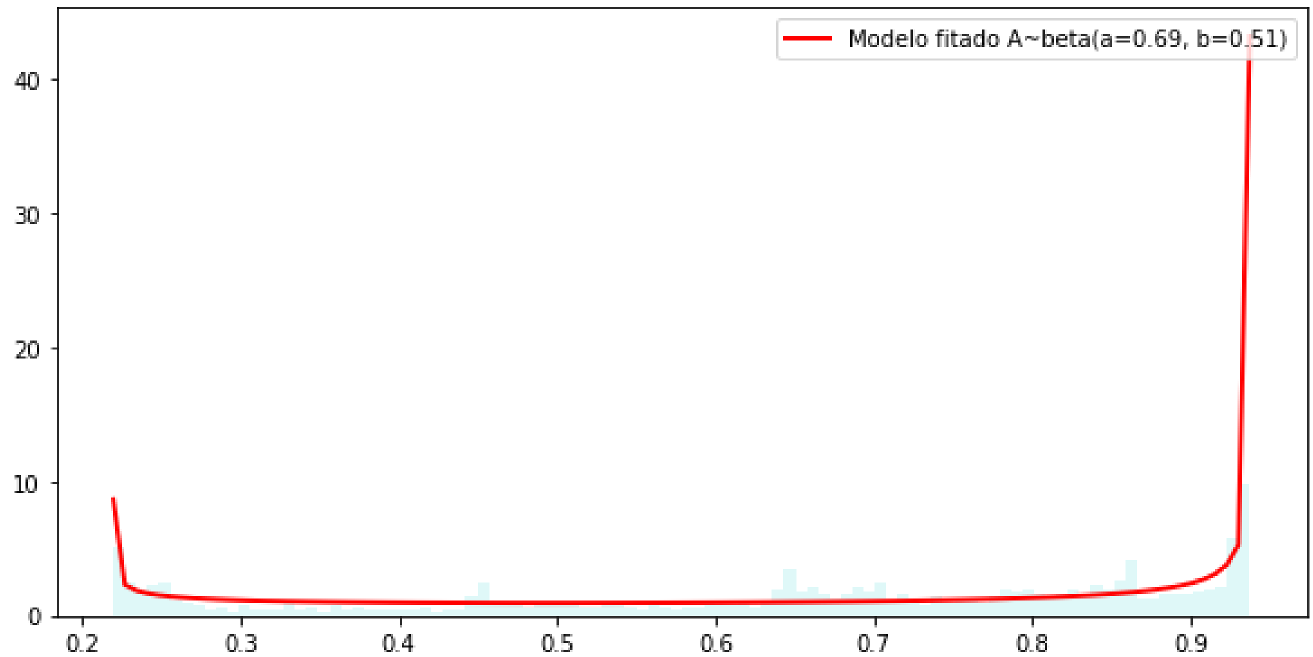
Out[17]:



2.5 Fitando melhor distribuição segundo método de Cullen-Frey

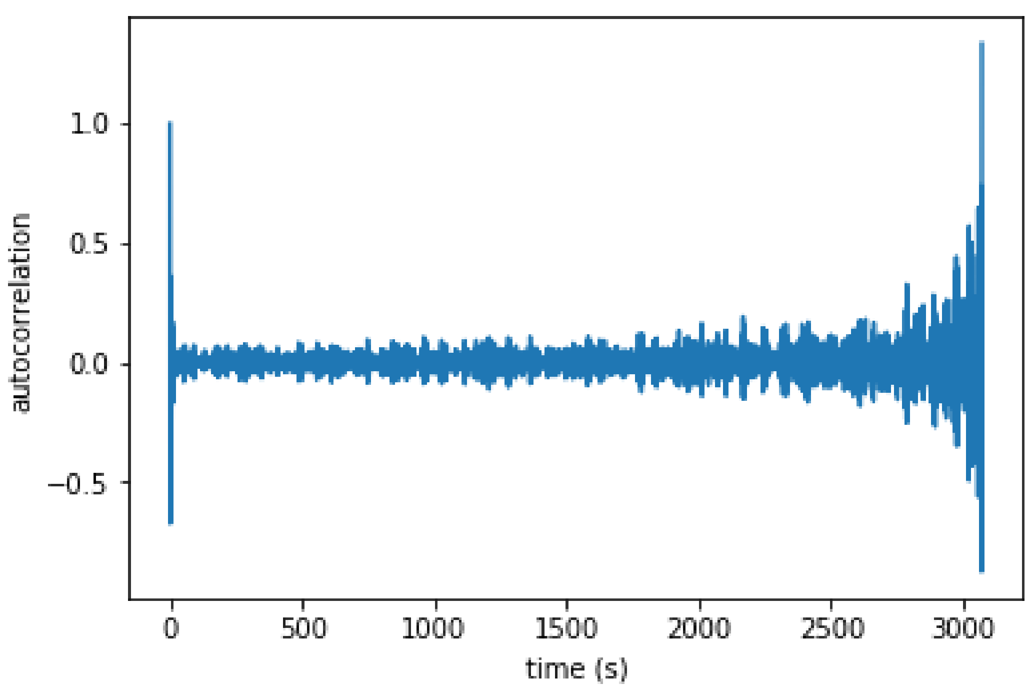
```
In [18]: aux.fitting_beta_distribution(A)
```

```
parametros de fitting:  (0.69159454277228771, 0.51069396728316085, 0.21962658171245464, 0.71797341243232
        Fitado                         Original
mean :  0.6326276956222016          0.651618001356
var  :  0.05719227904352447 4          0.0531894154818
skew :  -0.2821242716214038          -0.5338388055354238
kurt :  -1.3368132760120015          -0.9885722826698675
```



2.6 Calculando autocorrelação

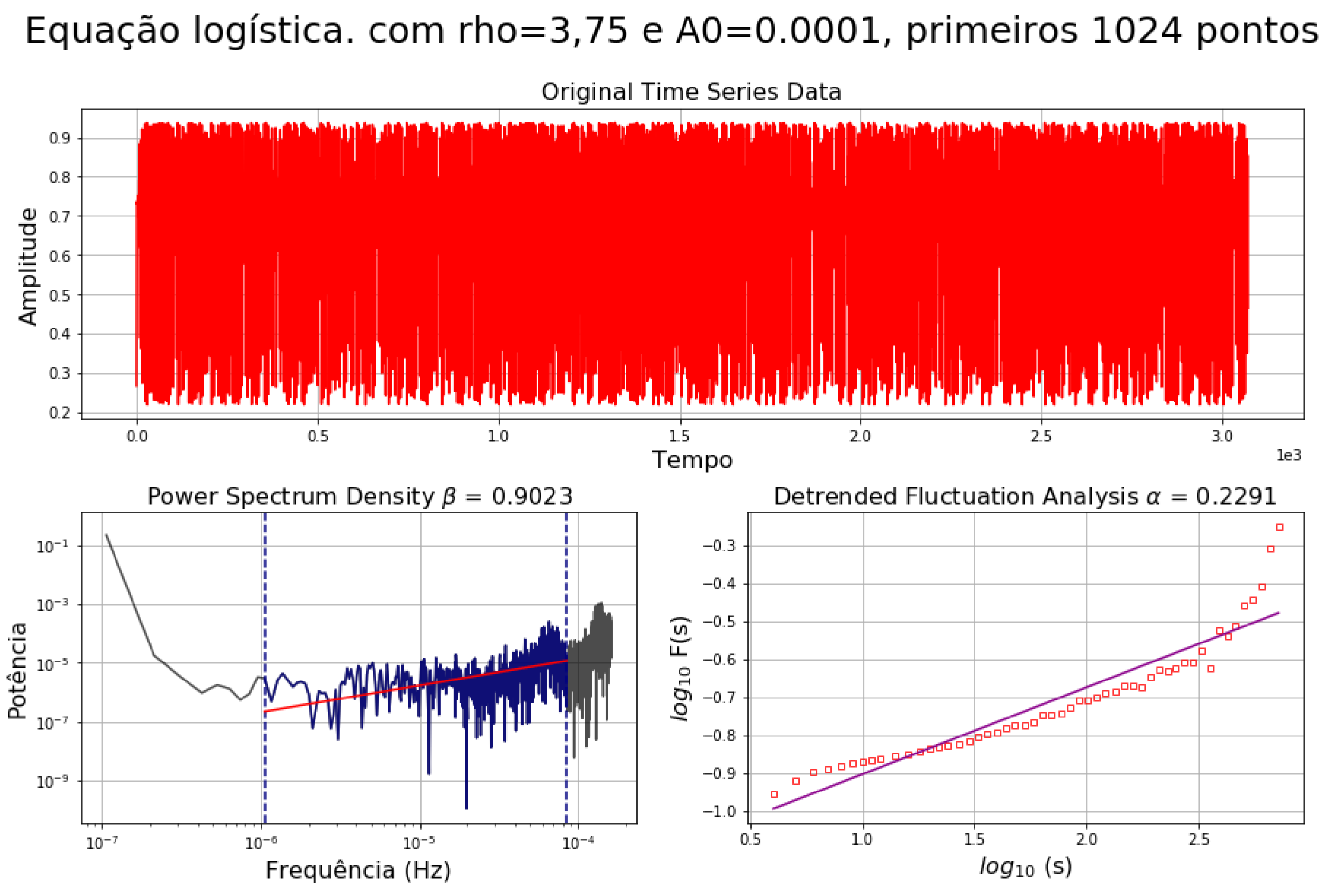
```
In [19]: aux.plot_estimated_autocorrelation(t, A, 0, len(A))
```



2.7 Plotando DFA e PSD

```
In [20]: aux.plot_psd_dfa(A, 'Equação logística. com rho=3,75 e A0=0.0001, primeiros 1024 pontos')
```

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

First 10 points: [ 0.26786644  0.73542754  0.72965202  0.73972482  0.72199505  0.75269325
  0.69804796  0.79041377  0.62122441  0.88239241]


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



3 Analise dos últimos 1024 pontos

In [21]:
```
A = save_A[3*1024:4096]
name = "A.ex:1.1.a"
savetxt(name + ".txt", A)
```

In [22]:
```
A.shape
```

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

3.1 Calculando os momentos do ensemble

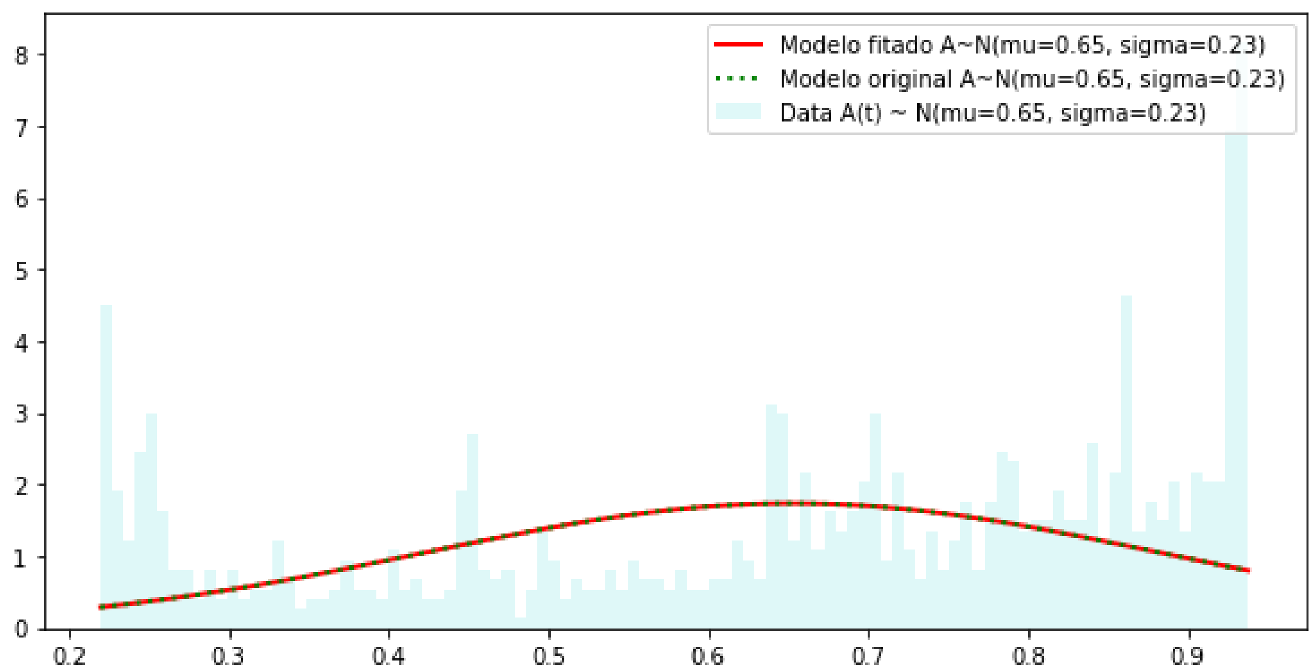
In [23]:
```
A_mean, A_var, A_skew, A_kurtosis = aux.calcMoments(A)

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 :  0.652503057542
var  :  0.0526056118148
skew :  -0.534201036962
kurt :  -0.99536747191
Q1   :  0.457517180012
Q3   :  0.857698366349
```

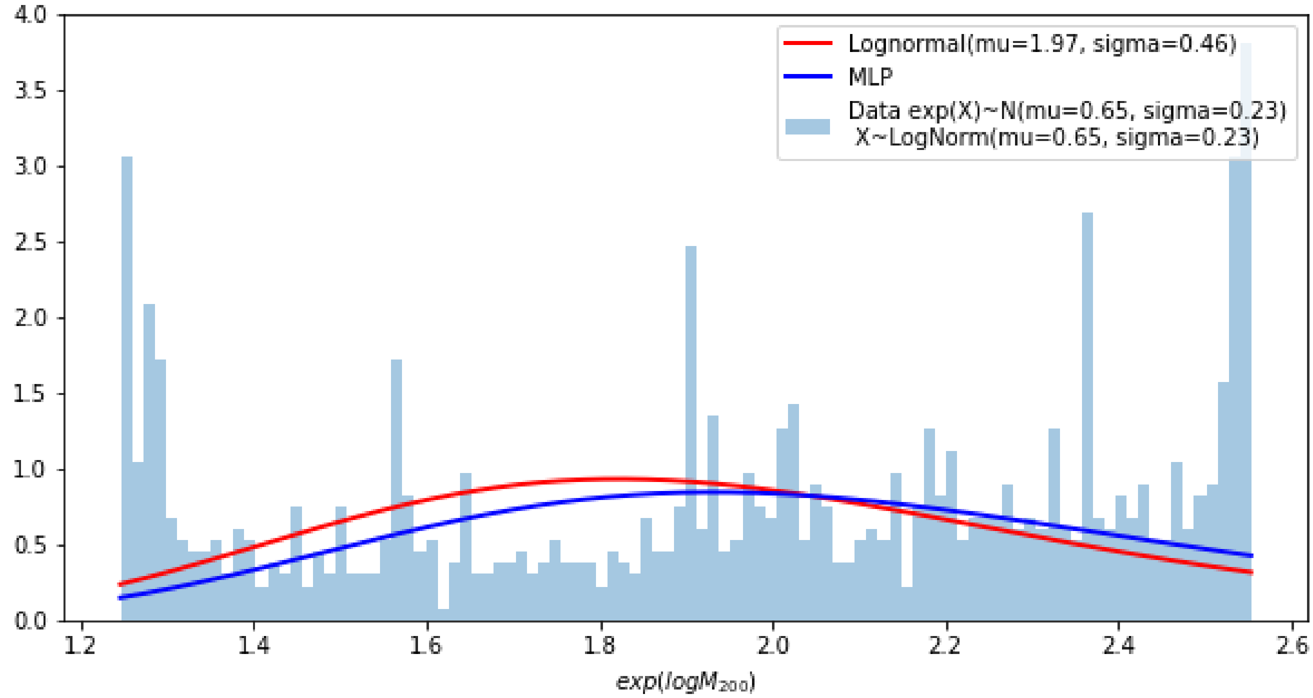
3.2 Fitando uma distribuição normal

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



3.3 Fitando uma distribuição lognormal

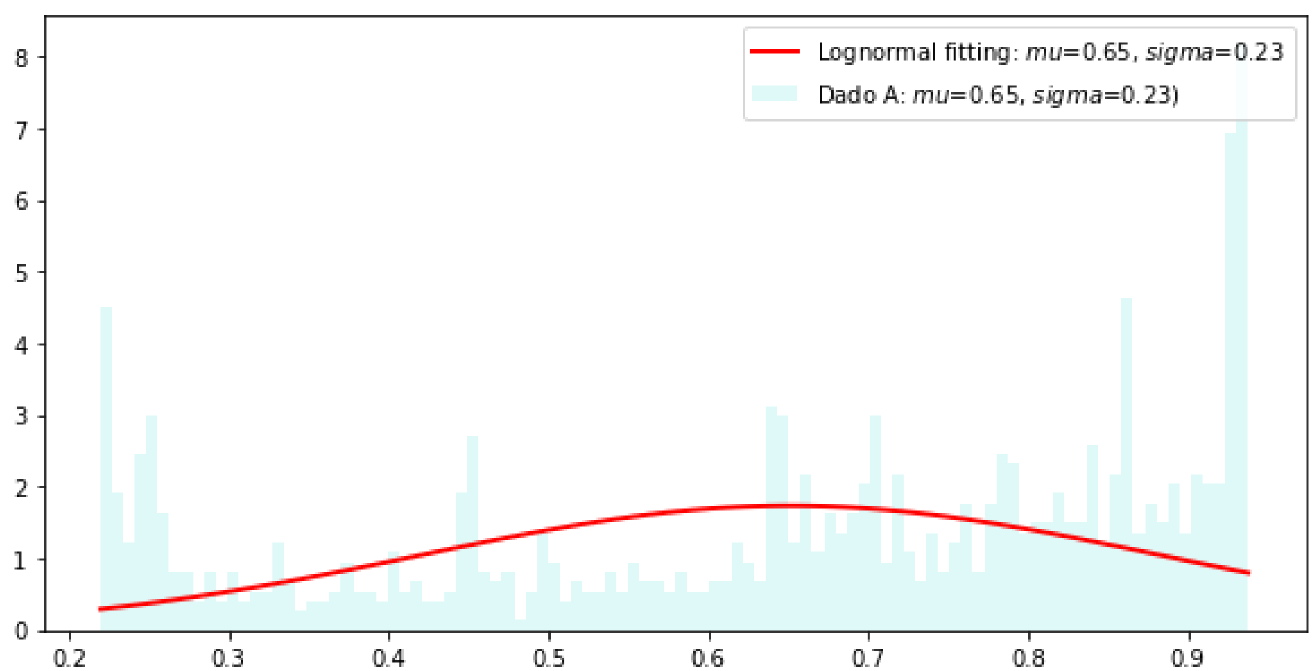
In [25]: `aux.fitting_lognormal_and_mlp_distribution(A)`



3.3.1 Fitando uma distribuição lognormal (utlizando minha implementação)

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

```
parametros de fitting:  (0.0029028469031551069, -78.587345644237729, 79.239098880198924)
        Fitado                          Original
mean :  0.6520870915959165           0.652503057542
var  :  0.052909396603846255           0.0526056118148
skew :  0.00870858351621843          -0.5342010369622291
kurt :  0.00013482595544900278          -0.9953674719103756
```

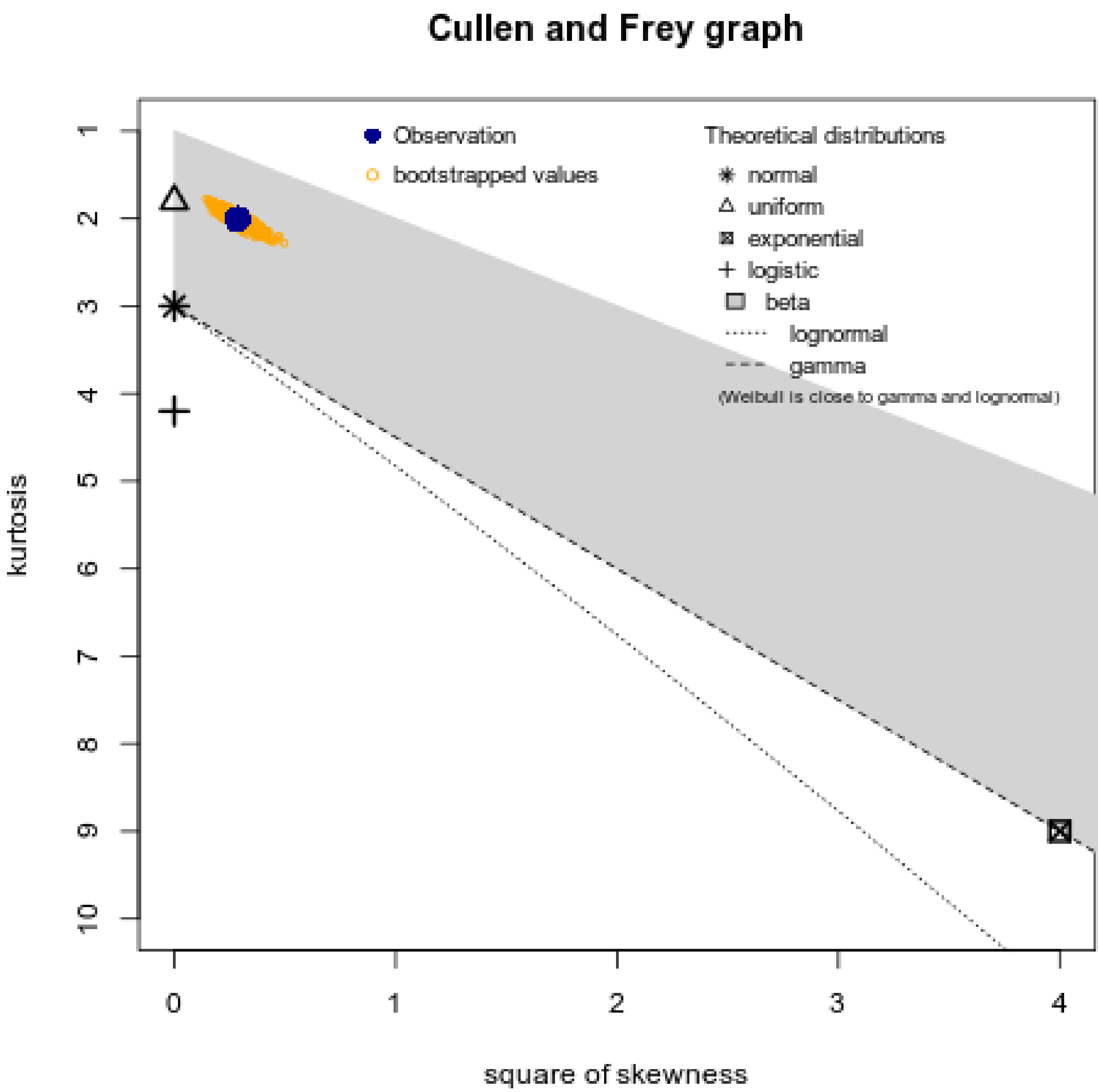


3.4 Plotando dados no espaço de Cullen-Frey

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:  0.2197266   max:  0.9375
median:  0.700494
mean:  0.6525031
estimated sd:  0.2294712
estimated skewness:  -0.534985
estimated kurtosis:  2.005638
```

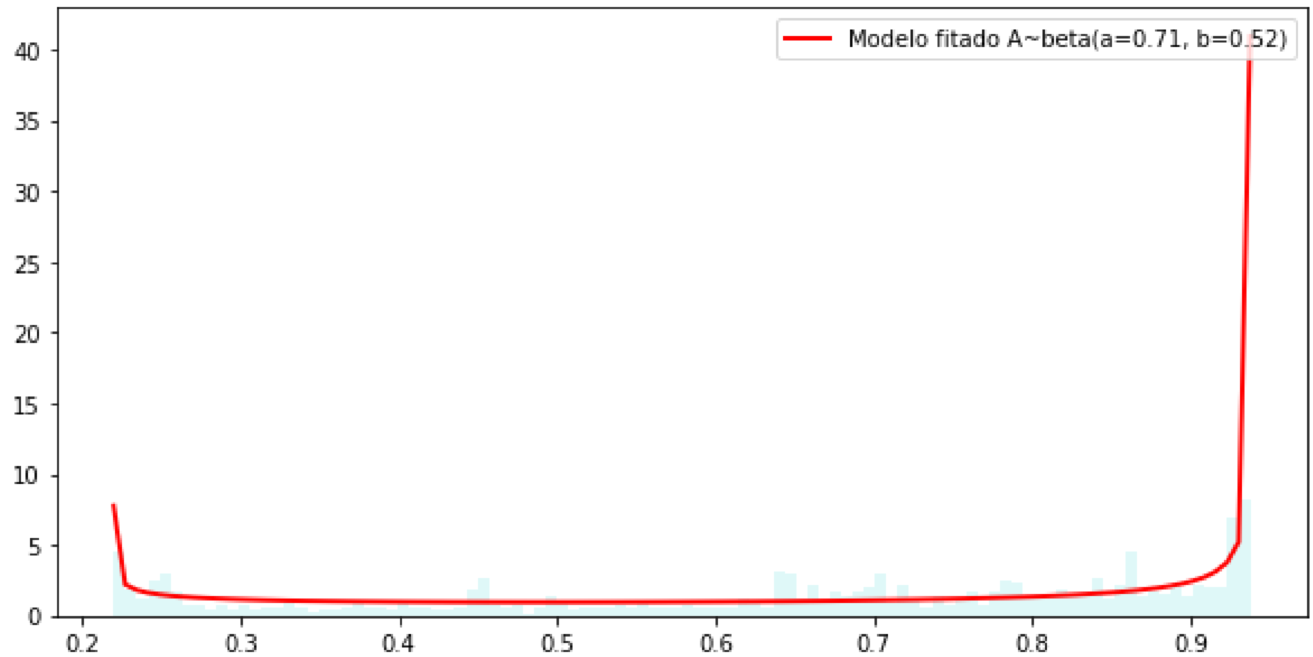
Out[27]:



3.5 Fitando melhor distribuição segundo método de Cullen-Frey

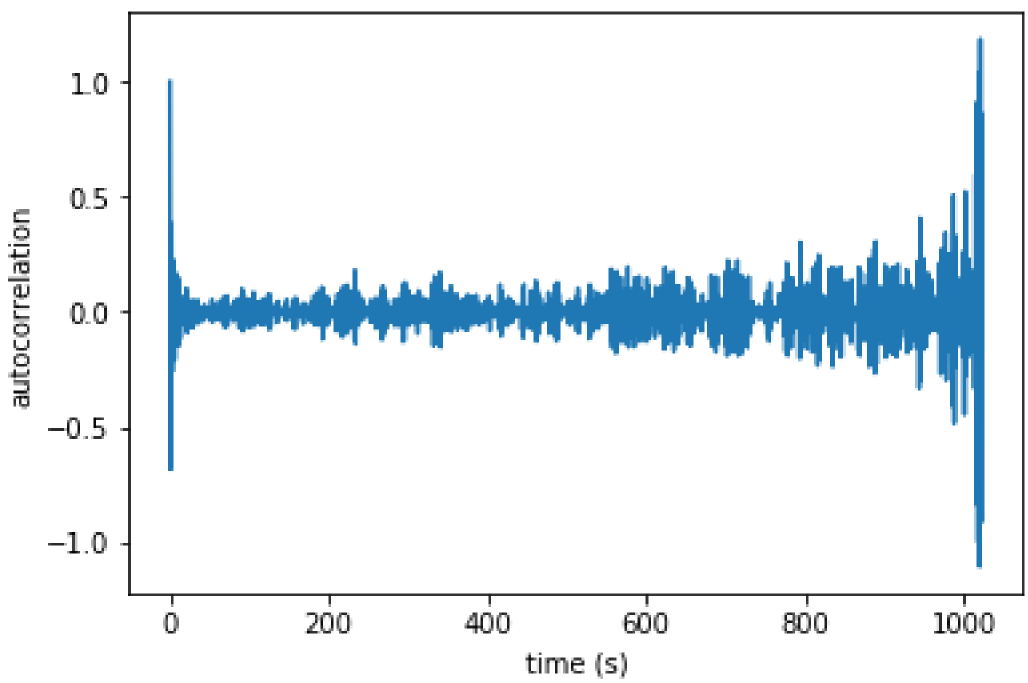
```
In [28]: aux.fitting_beta_distribution(A)
```

```
parametros de fitting:  (0.7075383942827802, 0.52017595579851184, 0.21962658171245464, 0.717973412432321
        Fitado                         Original
mean :  0.6333985273905811          0.652503057542
var  :  0.05650187277037103          0.0526056118148
skew :  -0.2856255417079101          -0.5342010369622291
kurt :  -1.325779059183752          -0.9953674719103756
```



3.6 Calculando autocorrelação

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



3.7 Plotando DFA e PSD

```
In [30]: aux.plot_psd_dfa(A, 'Equação logística. com rho=3,75 e A0=0.0001, últimos 1024 pontos')
```

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

First 10 points: [ 0.40959003  0.90684764  0.31678125  0.81161583  0.5733584   0.91731955
  0.28441649  0.76321406  0.67769384  0.81909337]


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