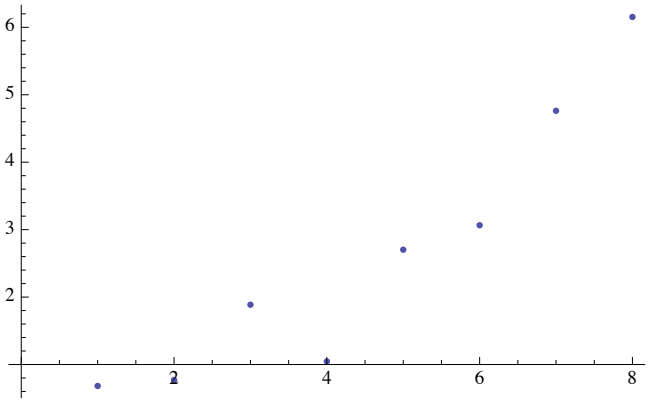
Exercícios
Cap. 5 — Notas apoio 2011/12

- **Exercício 5.2**

```
data = {0.41, 0.58, 0.75, 0.83, 1.00, 1.08, 1.17, 1.25, 1.35};
n = Length[data];
MatrixForm[
 Table[{i, data[[i]], data[[i + 1]] - data[[i]], 1/((n + 0.25) (data[[i + 1]] - data[[i]])),
   (n - i + 0.625)/(n + 0.25), 1/((n - i + 0.625) (data[[i + 1]] - data[[i]]))}, {i, 1, n - 1}]]
```

$$\begin{pmatrix} 1 & 0.41 & 0.17 & 0.63593 & 0.932432 & 0.682012 \\ 2 & 0.58 & 0.17 & 0.63593 & 0.824324 & 0.771456 \\ 3 & 0.75 & 0.08 & 1.35135 & 0.716216 & 1.88679 \\ 4 & 0.83 & 0.17 & 0.63593 & 0.608108 & 1.04575 \\ 5 & 1. & 0.08 & 1.35135 & 0.5 & 2.7027 \\ 6 & 1.08 & 0.09 & 1.2012 & 0.391892 & 3.06513 \\ 7 & 1.17 & 0.08 & 1.35135 & 0.283784 & 4.7619 \\ 8 & 1.25 & 0.1 & 1.08108 & 0.175676 & 6.15385 \end{pmatrix}$$

```
failurerate = Table[1/((n - i + 0.625) (data[[i + 1]] - data[[i]])), {i, 1, n - 1}];
ListPlot[failurerate]
```



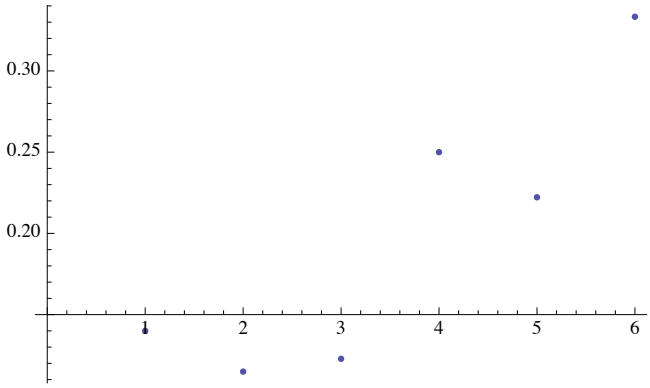
■ Exercício 5.3

```
limits = {0, 3, 6, 9, 12, 15, 18};
failures = {21, 10, 7, 9, 2, 1};
bins = Length[failures];
survivors = {50};
j = 1;
While[j ≤ bins,
 survivors = Append[survivors, survivors[[j]] - failures[[j]]]; j++]

n = survivors[[1]];
MatrixForm[
 Table[{j, limits[[j]], limits[[j + 1]], survivors[[j]], survivors[[j]] - survivors[[j + 1]],
   N[(survivors[[j]] - survivors[[j + 1]])/(n × (limits[[j + 1]] - limits[[j]])), 5], N[survivors[[j]]/n, 5],
   N[(survivors[[j]] - survivors[[j + 1]])/(survivors[[j]] × (limits[[j + 1]] - limits[[j]])), 5]}, {j, 1, bins}]]
```

$$\text{failurerate} = \text{Table}\left[\frac{\text{survivors}[[j]] - \text{survivors}[[j+1]]}{\text{survivors}[[j]] \times (\text{limits}[[j+1]] - \text{limits}[[j]])}, \{j, 1, \text{bins}\}\right];$$

```
ListPlot[failurerate]
```

1	0	3	50	21	0.14000	1.0000	0.14000
2	3	6	29	10	0.066667	0.58000	0.11494
3	6	9	19	7	0.046667	0.38000	0.12281
4	9	12	12	9	0.060000	0.24000	0.25000
5	12	15	3	2	0.013333	0.060000	0.22222
6	15	18	1	1	0.0066667	0.020000	0.33333

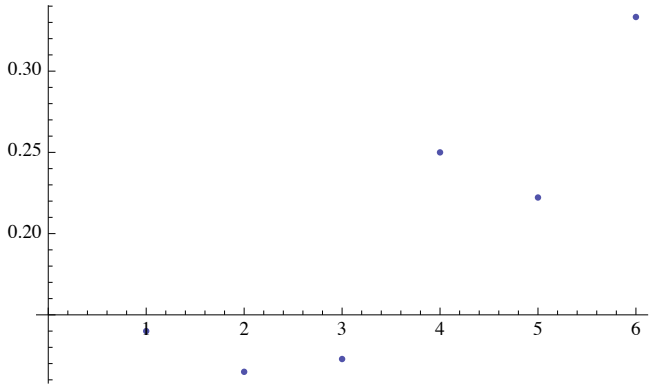


■ Exercício 5.4

```
limits = {0, 100, 200, 300, 400, 500, 600, 700, 800, 900, 1000};
failures = {121, 80, 70, 63, 30, 25, 21, 10, 7, 5};
bins = Length[failures];
survivors = {432};
j = 1;
While[j ≤ bins,
 survivors = Append[survivors, survivors[[j]] - failures[[j]]]; j++]

n = survivors[[1]];
MatrixForm[
 Table[{j, limits[[j]], limits[[j + 1]], survivors[[j]], survivors[[j]] - survivors[[j + 1]],
   N[100 × (survivors[[j]] - survivors[[j + 1]]) / (n × (limits[[j + 1]] - limits[[j]])), 5], N[survivors[[j]] / n, 5],
   N[100 × (survivors[[j]] - survivors[[j + 1]]) / (survivors[[j]] × (limits[[j + 1]] - limits[[j]])), 5]}, {j, 1, bins}]]
```

```
failureratetimeshundred =
  Table[100 × (survivors[[j]] - survivors[[j + 1]]) / (survivors[[j]] × (limits[[j + 1]] - limits[[j]])), {j, 1, bins}];
ListPlot[failurerate]
```

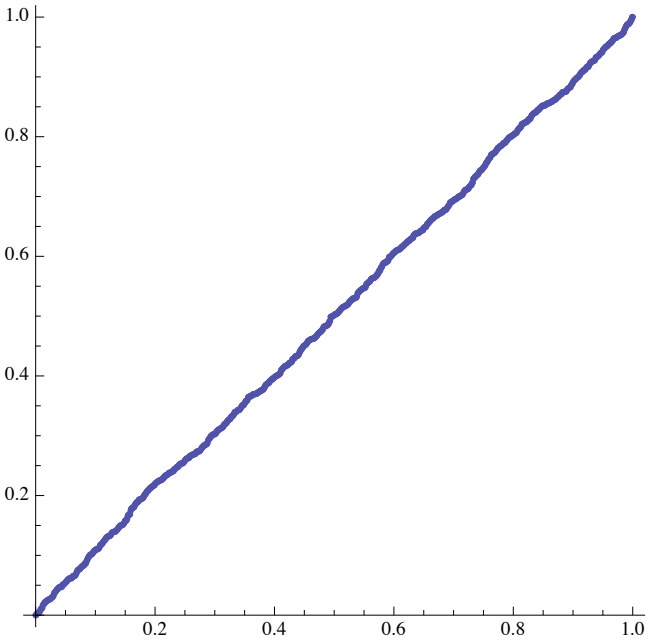
1	0	100	432	121	0.28009	1.0000	0.28009
2	100	200	311	80	0.18519	0.71991	0.25723
3	200	300	231	70	0.16204	0.53472	0.30303
4	300	400	161	63	0.14583	0.37269	0.39130
5	400	500	98	30	0.069444	0.22685	0.30612
6	500	600	68	25	0.057870	0.15741	0.36765
7	600	700	43	21	0.048611	0.099537	0.48837
8	700	800	22	10	0.023148	0.050926	0.45455
9	800	900	12	7	0.016204	0.027778	0.58333
10	900	1000	5	5	0.011574	0.011574	1.0000



■ Exercício 5.6 (Gráfico TTT: Exp, Weibull-DHR, Weibull-IHR)

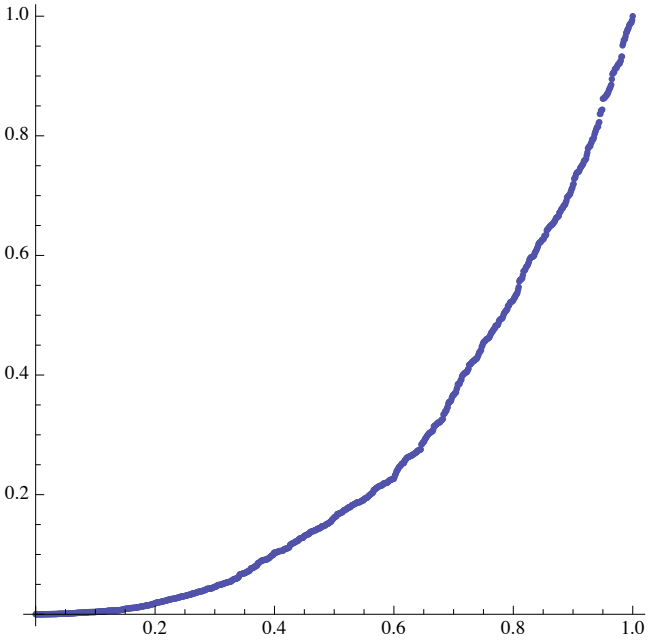
```
n = Input["Introduza o valor de n"]
dist = ExponentialDistribution[1];
t = Sort[RandomReal[dist, n]];
spac = Table[If[i == 1, t[[i]], t[[i]] - t[[i - 1]]], {i, 1, n}];
t = Flatten[{{0}, t}];

x = 0;
tau = {0};
Do[x = x + (n - i + 1) × spac[[i]]; tau = Append[tau, x], {i, 1, n}];
list1 = Table[{i/n, tau[[i + 1]]/tau[[n + 1]]}, {i, 0, n}];
ListPlot[list1, AspectRatio → 1]
```

```
1000
```

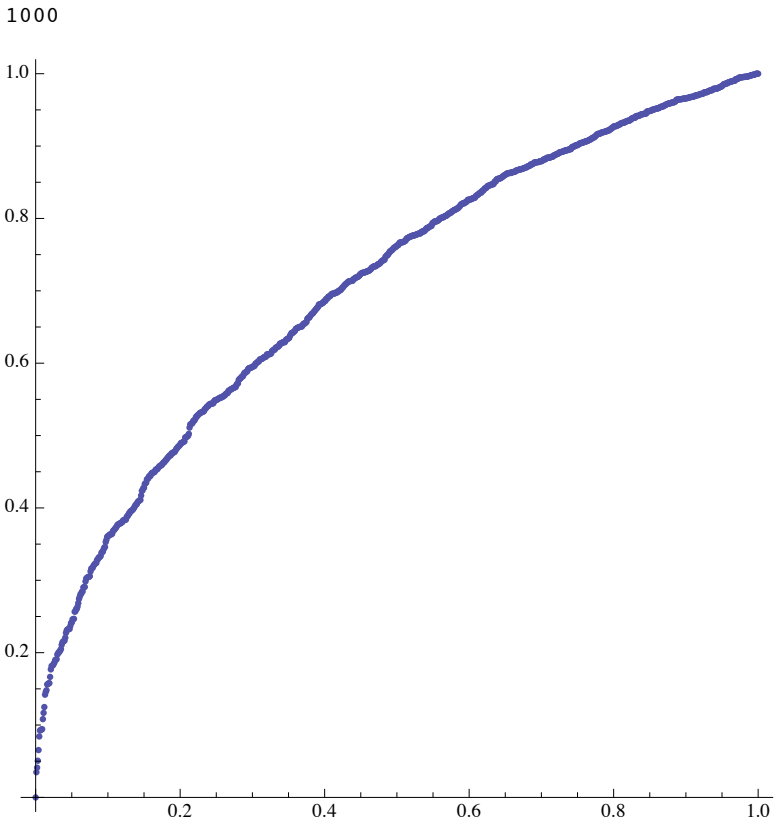


```
n = Input["Introduza o valor de n"]
dist = WeibullDistribution[0.5, 1];
t = Sort[RandomReal[dist, n]];
spac = Table[If[i == 1, t[[i]], t[[i]] - t[[i - 1]]], {i, 1, n}];
t = Flatten[{{0}, t}];

x = 0;
tau = {0};
Do[x = x + (n - i + 1) × spac[[i]]; tau = Append[tau, x], {i, 1, n}];
list1 = Table[{i/n, tau[[i + 1]]/tau[[n + 1]]}, {i, 0, n}];
ListPlot[list1, AspectRatio → 1]
```

```
1000
```



```
n = Input["Introduza o valor de n"]
dist = WeibullDistribution[2, 1];
t = Sort[RandomReal[dist, n]];
spac = Table[If[i == 1, t[[i]], t[[i]] - t[[i - 1]]], {i, 1, n}];
t = Flatten[{{0}, t}];

x = 0;
tau = {0};
Do[x = x + (n - i + 1) × spac[[i]]; tau = Append[tau, x], {i, 1, n}];
list1 = Table[{i/n, tau[[i + 1]]/tau[[n + 1]]}, {i, 0, n}];
ListPlot[list1, AspectRatio → 1]
```

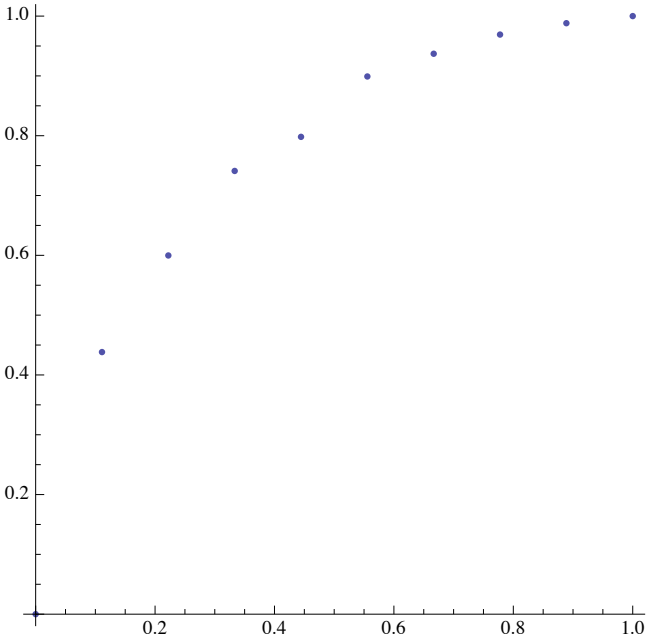


■ Exercício 5.7 (Gráfico TTT)

```
t = {0.41, 0.58, 0.75, 0.83, 1, 1.08, 1.17, 1.25, 1.35};
n = Length[t];
spac = Table[If[i == 1, t[[i]], t[[i]] - t[[i - 1]]], {i, 1, n}];
t = Flatten[{{0}, t}];
x = 0;
tau = {0};
Do[x = x + (n - i + 1) × spac[[i]]; tau = Append[tau, x], {i, 1, n}];

MatrixForm[Table[{i, t[[i + 1]], spac[[i]], n - i + 1,
    (n - i + 1) × spac[[i]], tau[[i + 1]], tau[[i + 1]] / tau[[n + 1]]}, {i, 1, n}]]
```

```
list1 = Table[{i / n, tau[[i + 1]] / tau[[n + 1]]}, {i, 0, n}];
ListPlot[list1, AspectRatio → 1]
```

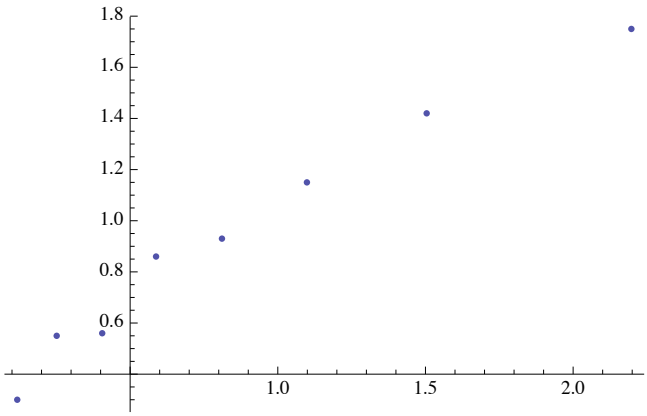
1	0.41	0.41	9	3.69	3.69	0.438242
2	0.58	0.17	8	1.36	5.05	0.599762
3	0.75	0.17	7	1.19	6.24	0.741093
4	0.83	0.08	6	0.48	6.72	0.7981
5	1	0.17	5	0.85	7.57	0.89905
6	1.08	0.08	4	0.32	7.89	0.937055
7	1.17	0.09	3	0.27	8.16	0.969121
8	1.25	0.08	2	0.16	8.32	0.988124
9	1.35	0.1	1	0.1	8.42	1.



■ Exercício 5.10 (Papel de probabilidade exponencial)

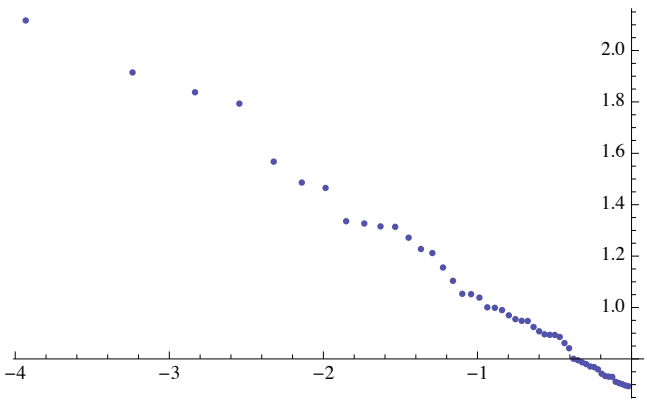
```
t = {0.30, 0.55, 0.56, 0.86, 0.93, 1.15, 1.42, 1.75};
n = Length[t];
pp = Table[{N[Log[(n + 1)/(n - i + 1)], 5], t[[i]]}, {i, 1, n}];
MatrixForm[pp]
ListPlot[pp]
```

$$\begin{pmatrix} 0.11778 & 0.3 \\ 0.25131 & 0.55 \\ 0.40547 & 0.56 \\ 0.58779 & 0.86 \\ 0.81093 & 0.93 \\ 1.0986 & 1.15 \\ 1.5041 & 1.42 \\ 2.1972 & 1.75 \end{pmatrix}$$



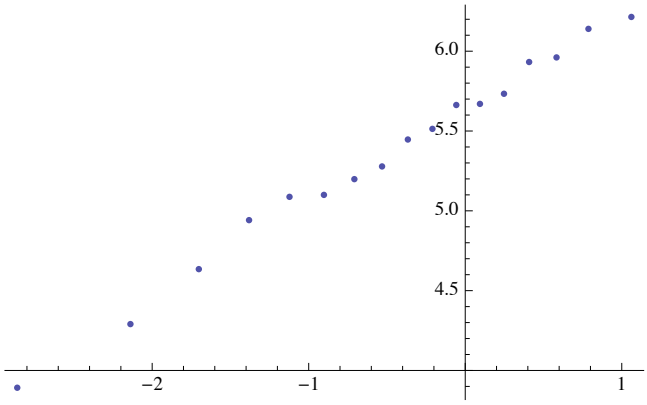
■ Exercício 5.11 (Papel de probabilidade Pareto)

```
t = {2.001, 2.007, 2.017, 2.026, 2.036, 2.075, 2.077 , 2.082, 2.101 , 2.137,
   2.156 , 2.161 , 2.181 , 2.196 , 2.214, 2.227 , 2.320, 2.367, 2.424 , 2.443,
   2.444 , 2.449 , 2.478, 2.520 , 2.579, 2.581 , 2.598 , 2.637 , 2.691, 2.715,
   2.720 , 2.825, 2.863 , 2.867, 3.016 , 3.176, 3.360, 3.413 , 3.567, 3.721,
   3.727, 3.769, 3.803 , 4.329, 4.420 , 4.795 , 6.009 , 6.281, 6.784 , 8.305};
n = Length[t];
pp = Table[{N[Log[(n - i + 1)/(n + 1)], 5], Log[t[[i]]]}, {i, 1, n}];
ListPlot[pp]
```



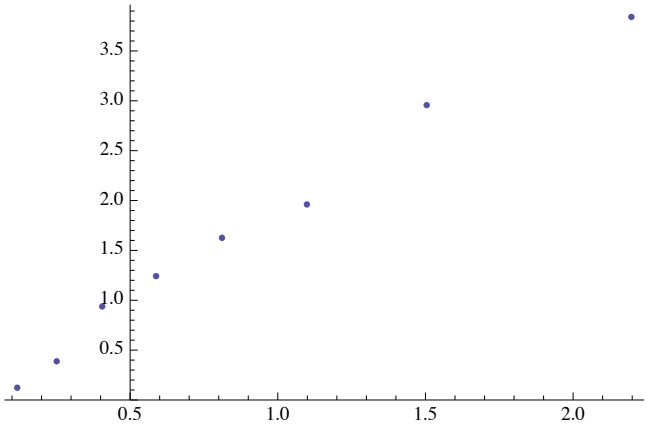
Exercício 5.12 (Papel de probabilidade Weibull)

```
t = {49, 73, 103, 140, 162, 164, 181, 196, 232, 248, 288, 290, 309, 377, 388, 464, 500};
n = Length[t];
pp = Table[{N[Log[Log[(n + 1)/(n - i + 1)]], 5], Log[t[[i]]]}, {i, 1, n}];
ListPlot[pp]
```



- ### Exercício 5.13 (Papel de probabilidade Exponencial)

```
t = Sort[{1.242, 1.626, 0.123, 2.957, 0.388, 3.841, 1.961, 0.938}];
n = Length[t];
pp = Table[{N[Log[(n + 1)/(n - i + 1)], 5], t[[i]]}, {i, 1, n}];
ListPlot[pp]
```



■ Exercício 5.14 (Teste de Kolmogorov-Smirnov)

```
data = Sort[{1.242, 1.626, 0.123, 2.957, 0.388, 3.841, 1.961, 0.938}];
n = Length[data];
fde = Table[i / n, {i, 1, n}];
fdeatras = Table[(i - 1) / n, {i, 1, n}];
fdconjecturada = Table[1 - Exp[-0.56 × data[[i]]], {i, 1, n}];
fdemenosfdc = fde - fdconjecturada;
fdcmenosfdeatras = fdconjecturada - fdeatras;
values = TableForm[
  Transpose[{data, fde, fdeatras, fdconjecturada, fdemenosfdc, fdcmenosfdeatras}],
  TableHeadings → {Automatic,
    {"x(i)", "i/n", "(i-1)/n", "F0(x(i))", "i/n-F0(x(i))", "F0(x(i))-(i-1)/n"}}]
dplus = Max[Max[fdemenosfdc], 0]
dminus = Max[Max[fdcmenosfdeatras], 0]
Max[dplus, dminus]
Print["Valor obs. <= pontos críticos 0.4543 (5%) e
   0.5418 (1%), pelo que não devemos rejeitar H0 a qualquer n.s. <=5%."]
```

	x(i)	i/n	(i-1)/n	F0(x(i))	i/n-F0(x(i))	F0(x(i))-(i-1)/n
1	0.123	$\frac{1}{8}$	0	0.0665613	0.0584387	0.0665613
2	0.388	$\frac{1}{4}$	$\frac{1}{8}$	0.195295	0.0547046	0.0702954
3	0.938	$\frac{3}{8}$	$\frac{1}{4}$	0.40861	-0.0336102	0.15861
4	1.242	$\frac{1}{2}$	$\frac{3}{8}$	0.501185	-0.001185	0.126185
5	1.626	$\frac{5}{8}$	$\frac{1}{2}$	0.597701	0.0272989	0.0977011
6	1.961	$\frac{3}{4}$	$\frac{5}{8}$	0.666516	0.0834841	0.0415159
7	2.957	$\frac{7}{8}$	$\frac{3}{4}$	0.809084	0.0659163	0.0590837
8	3.841	1	$\frac{7}{8}$	0.883628	0.116372	0.00862761

```
0.116372

0.15861

0.15861

Valor obs. <= pontos críticos 0.4543 (5%) e
  0.5418 (1%), pelo que não devemos rejeitar H0 a qualquer n.s. <=5%.
```