Package ‘exptest’

February 19, 2015

Version 1.2
Date 2013-11-30
Title Tests for Exponentiality
Author Alexey Novikov, Ruslan Pusev, Maxim Yakovlev
Maintainer Ruslan Pusev <r.pusev@spbu.ru>
Description Tests for the composite hypothesis of exponentiality
License GPL (>= 3)
NeedsCompilation no
Repository CRAN
Date/Publication 2013-12-01 07:58:31

R topics documented:

ahsanullah.exp.test ............................................. 2
atkinson.exp.test .................................................. 3
ci.exp.test .......................................................... 4
cvm.exp.test ......................................................... 6
deshpande.exp.test ............................................... 7
ep.exp.test .......................................................... 8
epstein.exp.test ..................................................... 9
frozini.exp.test ..................................................... 10
gini.exp.test ......................................................... 11
gnedenko.exp.test ................................................ 13
harris.exp.test ..................................................... 14
hegazy1.exp.test .................................................. 15
hegazy2.exp.test .................................................. 16
hollander.exp.test ................................................ 17
kimber.exp.test ..................................................... 18
kochar.exp.test ..................................................... 19
ks.exp.test ........................................................ 20
lorenz.exp.test ..................................................... 21
moran.exp.test ..................................................... 23
pietra.exp.test ..................................................... 24
ahsanullah.exp.test

Description

Performs test for the composite hypothesis of exponentiality based on the Ahsanullah characterization, see Volkova and Nikitin (2013).

Usage

ahsanullah.exp.test(x, simulate.p.value=FALSE, nrepl=2000)

Arguments

x a numeric vector of data values.

simulate.p.value

a logical value indicating whether to compute p-values by Monte Carlo simulation.

nrepl the number of replications in Monte Carlo simulation.

Details

The test is based on the following statistic:

\[ I_n = \int_0^\infty (H_n(t) - G_n(t))dF_n(t), \]

where \( F_n \) is the empirical distribution function,

\[ H_n(t) = \frac{1}{n^2} \sum_{i,j=1}^{n} 1\{|X_i - X_j| < t\}, \quad t \geq 0, \]

\[ G_n(t) = \frac{1}{n^2} \sum_{i,j=1}^{n} 1\{2 \min(X_i, X_j) < t\}, \quad t \geq 0. \]

Under exponentiality, one has

\[ \sqrt{n}I_n \xrightarrow{d} \mathcal{N}\left(0, \frac{647}{4725}\right) \]

(see Volkova and Nikitin (2013)).
atkinson.exp.test

Value
A list with class "htest" containing the following components:

- statistic: the value of the test statistic.
- p.value: the p-value for the test.
- method: the character string "Test for exponentiality based on Ahsanullah characterization".
- data.name: a character string giving the name(s) of the data.

Author(s)
Alexey Novikov and Ruslan Pusev

References

Examples
ahsanullah.exp.test(rexp(25))
ahsanullah.exp.test(rgamma(25,2))

Description
Performs Atkinson test for the composite hypothesis of exponentiality, see e.g. Mimoto and Zitikis (2008).

Usage
atkinson.exp.test(x, p=0.99, simulate.p.value=FALSE, nrepl=2000)

Arguments
- x: a numeric vector of data values.
- p: a parameter of the test (see below).
- simulate.p.value: a logical value indicating whether to compute p-values by Monte Carlo simulation.
- nrepl: the number of replications in Monte Carlo simulation.
The Atkinson test for exponentiality is based on the following statistic:

\[ T_n(p) = \sqrt{n} \left| \frac{1}{n} \sum_{i=1}^{n} X_i^p \right|^{1/p} - (\Gamma(1 + p))^{1/p} \frac{1}{\sigma(p)} \]

The statistic is asymptotically normal: \( T_n(p) \rightarrow N(0, \sigma^2(p)) \), where

\[ \sigma^2(p) = \left( \frac{1}{p} - \frac{1}{p^2} + \frac{\Gamma(1 + 2p)}{p^2 \Gamma^2(1 + p)} \right) \]

A list with class "htest" containing the following components:

- statistic: the value of the Atkinson statistic.
- p.value: the p-value for the test.
- method: the character string "Atkinson test for exponentiality".
- data.name: a character string giving the name(s) of the data.

Author(s)
Alexey Novikov and Ruslan Pusev

References

Examples
atkinson.exp.test(rexp(100))
atkinson.exp.test(rchisq(100,3))

co.exp.test  Test for exponentiality of Cox and Oakes

Description
Performs Cox and Oakes test for the composite hypothesis of exponentiality, see e.g. Henze and Meintanis (2005, Sec. 2.5).

Usage
co.exp.test(x, simulate.p.value=FALSE, nrepl=2000)
co.exp.test

Arguments

x a numeric vector of data values.
simulate.p.value a logical value indicating whether to compute p-values by Monte Carlo simulation.
nrepl the number of replications in Monte Carlo simulation.

Details

The Cox and Oakes test is a test for the composite hypothesis of exponentiality. The test statistic is

\[ CO_n = n + \sum_{j=1}^{n} (1 - Y_j) \log Y_j, \]

where \( Y_j = \frac{X_j}{X}, \) \((6/n)^{1/2}(CO_n/\pi)\) is asymptotically standard normal (see, e.g., Henze and Meintanis (2005, Sec. 2.5)).

Value

A list with class "htest" containing the following components:

- statistic the value of the Cox and Oakes statistic.
- p.value the p-value for the test.
- method the character string "Test for exponentiality based on the statistic of Cox and Oakes".
- data.name a character string giving the name(s) of the data.

Author(s)

Alexey Novikov, Ruslan Pusev and Maxim Yakovlev

References


Examples

co.exp.test(rexp(100))
co.exp.test(runif(100, min = 0, max = 1))
cvm.exp.test  

Cramer-von Mises test for exponentiality

Description

Performs Cramer-von Mises test for the composite hypothesis of exponentiality, see e.g. Henze and Meintanis (2005, Sec. 2.1).

Usage

cvm.exp.test(x, nrepl=2000)

Arguments

x          a numeric vector of data values.
nrepl      the number of replications in Monte Carlo simulation.

Details

The Cramer-von Mises test for exponentiality is based on the following statistic:

\[ \omega_n^2 = \int_0^\infty (F_n(x) - (1 - \exp(-x)))^2 \exp(-x) dx, \]

where \( F_n \) is the empirical distribution function of the scaled data \( Y_j = X_j/X \). The p-value is computed by Monte Carlo simulation.

Value

A list with class "htest" containing the following components:

- p.value: the p-value for the test.
- method: the character string "Cramer-von Mises test for exponentiality".
- data.name: a character string giving the name(s) of the data.

Author(s)

Ruslan Pusev and Maxim Yakovlev

References


Examples

cvm.exp.test(rexp(100))
cvm.exp.test(runif(100, min = 50, max = 100))
deshpande.exp.test  Deshpande test for exponentiality

Description
Performs Deshpande test for the composite hypothesis of exponentiality, see Deshpande (1983).

Usage
deshpande.exp.test(x, b=0.44, simulate.p.value=FALSE, nrepl=2000)

Arguments
- x: a numeric vector of data values.
- b: a parameter of the test (see below).
- simulate.p.value: a logical value indicating whether to compute p-values by Monte Carlo simulation.
- nrepl: the number of replications in Monte Carlo simulation.

Details
The test is based on the following statistic:

\[ J = \frac{1}{n(n-1)} \sum_{i \neq j} 1\{x_i > bx_j\}. \]

Under exponentiality, one has

\[ \sqrt{n}(J - \frac{1}{b+1}) \xrightarrow{d} \mathcal{N}(0, 4\zeta_1), \]

where

\[ \zeta_1 = \frac{1}{4} \left( 1 + \frac{b}{b+2} + \frac{1}{2b+1} + \frac{2(1-b)}{b+1} - \frac{2b}{b^2+b+1} - \frac{4}{(b+1)^2} \right) \]

(see Deshpande (1983)).

Value
A list with class "htest" containing the following components:
- statistic: the value of the test statistic.
- p.value: the p-value for the test.
- method: the character string "Deshpande test for exponentiality".
- data.name: a character string giving the name(s) of the data.
Author(s)
Alexey Novikov and Ruslan Pusev

References

Examples
deshpande.exp.test(rexp(100))
deshpande.exp.test(rweibull(100L1.5))

despande.exp.test  Test for exponentiality of Epps and Pulley

Description
Performs Epps and Pulley test for the composite hypothesis of exponentiality, see e.g. Henze and Meintanis (2005, Sec. 2.8.1).

Usage
ep.exp.test(x, simulate.p.value=FALSE, nrepl=2000)

Arguments

x a numeric vector of data values.
simulate.p.value a logical value indicating whether to compute p-values by Monte Carlo simulation.
nrepl the number of replications in Monte Carlo simulation.

Details
The Epps and Pulley test is a test for the composite hypothesis of exponentiality. The test statistic is

\[ EP_n = (48n)^{1/2} \left( \frac{1}{n} \sum_{j=1}^{n} \exp(-Y_j) - \frac{1}{2} \right), \]

where \( Y_j = X_j/\bar{X} \). \( EP_n \) is asymptotically standard normal (see, e.g., Henze and Meintanis (2005, Sec. 2.8.1).
**epstein.exp.test**

**Value**

A list with class "htest" containing the following components:

- **statistic**: the value of the Epps and Pulley statistic.
- **p.value**: the p-value for the test.
- **method**: the character string "The test for exponentiality of Epps and Pulley".
- **data.name**: a character string giving the name(s) of the data.

**Author(s)**

Alexey Novikov, Ruslan Pusev and Maxim Yakovlev

**References**


**Examples**

```r
ep.exp.test(rexp(100))
ep.exp.test(runif(100L, min = 0L, max = 1))
```

**Description**

Performs Epstein test for the composite hypothesis of exponentiality, see e.g. Ascher (1990).

**Usage**

```r
epstein.exp.test(x, simulate.p.value=FALSE, nrepl=2000)
```

**Arguments**

- **x**: a numeric vector of data values.
- **simulate.p.value**: a logical value indicating whether to compute p-values by Monte Carlo simulation.
- **nrepl**: the number of replications in Monte Carlo simulation.
Details

The test is based on the following statistic:

\[ EPS_n = \frac{2n \left( \log \left( \sum_{i=1}^{n} D_i \right) - \sum_{i=1}^{n} \log(D_i) \right)}{1 + (n + 1)/(6n)}, \]

where \( D_i = (n - i + 1)(X_i - X_{i-1}) \), \( X_0 = 0 \) and \( X_1 \leq \ldots \leq X_n \) are the order statistics. Under exponentiality, \( EPS \) is approximately distributed as a chi-square with \( n - 1 \) degrees of freedom.

Value

A list with class "htest" containing the following components:

- statistic: the value of the test statistic.
- p.value: the p-value for the test.
- method: the character string "Epstein test for exponentiality".
- data.name: a character string giving the name(s) of the data.

Author(s)

Alexey Novikov, Ruslan Pusev and Maxim Yakovlev

References


Examples

epstein.exp.test(rexp(100))
epstein.exp.test(rweibull(100,2))

Description

Frozini test for exponentiality

Usage

frozini.exp.test(x, nrepl=2000)

Arguments

- x: a numeric vector of data values.
- nrepl: the number of replications in Monte Carlo simulation.
Details

The Frozini test for exponentiality is based on the following statistic:

\[ B_n = \frac{1}{\sqrt{n}} \sum_{i=1}^{n} \left| 1 - \exp \left( \frac{-X_i}{\bar{X}} \right) - \frac{i - 0.5}{n} \right|. \]

The p-value is computed by Monte Carlo simulation.

Value

A list with class "htest" containing the following components:

- statistic: the value of the Frozini statistic.
- p.value: the p-value for the test.
- method: the character string "Frozini test for exponentiality".
- data.name: a character string giving the name(s) of the data.

Author(s)

Alexey Novikov and Ruslan Pusev

References


Examples

```r
frozini.exp.test(rexp(100))
frozini.exp.test(rchisq(100, 2))
```

Description

Performs test for the composite hypothesis of exponentiality based on the Gini statistic, see e.g. Gail and Gastwirth (1978).

Usage

```r
gini.exp.test(x, simulate.p.value=FALSE, nrepl=2000)
```
Arguments

x         a numeric vector of data values.
simulate.p.value  a logical value indicating whether to compute p-values by Monte Carlo simulation.
nrepl  the number of replications in Monte Carlo simulation.

Details

The test is based on the Gini statistic

\[ G_n = \frac{\sum_{i,j=1}^{n} |X_i - X_j|}{2n(n - 1)\bar{X}}. \]

Under exponentiality, the normalized statistic \((12(n - 1))^{1/2}(G_n - 0.5)\) is asymptotically standard normal (see, e.g., Gail and Gastwirth (1978)).

Value

A list with class "htest" containing the following components:

- statistic         the value of the Gini statistic.
- p.value           the p-value for the test.
- method            the character string "Test for exponentiality based on the Gini statistic".
- data.name         a character string giving the name(s) of the data.

Author(s)

Alexey Novikov, Ruslan Pusev and Maxim Yakovlev

References


Examples

```
gini.exp.test(rexp(100))
gini.exp.test(runif(100, min = 0, max = 1))
```
Description

Performs Gnedenko F-test for the composite hypothesis of exponentiality, see e.g. Ascher (1990).

Usage

```r
gnedenko.exp.test(x, R=length(x)/2, simulate.p.value=FALSE, nrepl=2000)
```

Arguments

- `x`: a numeric vector of data values.
- `R`: a parameter of the test (see below).
- `simulate.p.value`: a logical value indicating whether to compute p-values by Monte Carlo simulation.
- `nrepl`: the number of replications in Monte Carlo simulation.

Details

The test is based on the following statistic:

\[ Q_n(R) = \frac{\sum_{i=1}^R D_i / R}{\sum_{i=R+1}^{n} D_i / (n - R)}, \]

where \( D_i = (n - i + 1)(X_i - X_{i-1}) \), \( X_{(0)} = 0 \) and \( X_{(1)} \leq \ldots \leq X_{(n)} \) are the order statistics. Under exponentiality, \( Q_n(R) \) has an F distribution with \( 2R \) and \( 2(n - R) \) degrees of freedom.

Value

A list with class "htest" containing the following components:

- `statistic`: the value of the test statistic.
- `p.value`: the p-value for the test.
- `method`: the character string "Gnedenko's F-test of exponentiality".
- `data.name`: a character string giving the name(s) of the data.

Author(s)

Alexey Novikov, Ruslan Pusev and Maxim Yakovlev

References

Examples

```r
gnedenko.exp.test(rexp(100))
gnedenko.exp.test(rweibull(100, 2))
```

---

**harris.exp.test**  
_Harris modification of Gnedenko F-test_

**Description**

Performs Harris modification of Gnedenko F-test for the composite hypothesis of exponentiality, see e.g. Ascher (1990).

**Usage**

```r
harris.exp.test(x, R=length(x)/4, simulate.p.value=FALSE, nrepl=2000)
```

**Arguments**

- **x**: a numeric vector of data values.
- **R**: a parameter of the test (see below).
- **simulate.p.value**: a logical value indicating whether to compute p-values by Monte Carlo simulation.
- **nrepl**: the number of replications in Monte Carlo simulation.

**Details**

The test is based on the following statistic:

\[
Q_n(R) = \frac{\left( \sum_{i=1}^{R} D_i + \sum_{i=R+1}^{n} D_i \right) / (2R)}{\sum_{i=R+1}^{n} D_i / (n - 2R)},
\]

where \( D_i = (n - i + 1)(X_{(i)} - X_{(i-1)}) \), \( X_{(0)} = 0 \) and \( X_{(1)} \leq \ldots \leq X_{(n)} \) are the order statistics. Under exponentiality, \( Q_n(R) \) has an F distribution with \( 4R \) and \( 2(n - 2R) \) degrees of freedom.

**Value**

A list with class "htest" containing the following components:

- **statistic**: the value of the test statistic.
- **p.value**: the p-value for the test.
- **method**: the character string "Harris modification of Gnedenko F-test".
- **data.name**: a character string giving the name(s) of the data.
Author(s)
Alexey Novikov, Ruslan Pusev and Maxim Yakovlev

References

Examples
harris.exp.test(rexp(100))
harris.exp.test(rlnorm(100))

Description
Performs Hegazy-Green test for the composite hypothesis of exponentiality, see e.g. Hegazy and Green (1975).

Usage
hegazy1.exp.test(x, nrepl=2000)

Arguments
x
  a numeric vector of data values.
nrepl
  the number of replications in Monte Carlo simulation.

Details
The Hegazy-Green test for exponentiality is based on the following statistic:

\[ T_1 = n^{-1} \sum \left| X_{(i)} + \ln \left( 1 - \frac{i}{n+1} \right) \right| \]

The p-value is computed by Monte Carlo simulation.

Value
A list with class "htest" containing the following components:

- statistic: the value of the Hegazy-Green statistic.
- p.value: the p-value for the test.
- method: the character string "Hegazy-Green test for exponentiality".
- data.name: a character string giving the name(s) of the data.
Author(s)
Alexey Novikov and Ruslan Pusev

References

Examples
hegazy1.exp.test(rexp(100))
hegazy1.exp.test(rweibull(100L1.5))

hegazy2.exp.test  Hegazy-Green test for exponentiality

Description
Performs Hegazy-Green test for the composite hypothesis of exponentiality, see e.g. Hegazy and Green (1975).

Usage
hegazy2.exp.test(x, nrepl=2000)

Arguments
x a numeric vector of data values.
nrepl the number of replications in Monte Carlo simulation.

Details
The Hegazy-Green test for exponentiality is based on the following statistic:

\[ T_2 = n^{-1} \sum \left( X_{(i)} + \ln \left( 1 - \frac{i}{n+1} \right) \right)^2. \]

The p-value is computed by Monte Carlo simulation.

Value
A list with class "htest" containing the following components:

- statistic the value of the Hegazy-Green statistic.
- p.value the p-value for the test.
- method the character string "Hegazy-Green test for exponentiality".
- data.name a character string giving the name(s) of the data.
Author(s)
Alexey Novikov and Ruslan Pusev

References

Examples
hegazy2.exp.test(rexp(100))
hegazy2.exp.test(rweibull(100L, 1.5))

hollander.exp.test

Hollander-Proshan test for exponentiality

Description
Performs Hollander-Proshan test for the composite hypothesis of exponentiality, see Hollander and Proshan (1972).

Usage
hollander.exp.test(x, simulate.p.value=FALSE, nrepl=2000)

Arguments

x
a numeric vector of data values.

simulate.p.value
a logical value indicating whether to compute p-values by Monte Carlo simulation.

nrepl
the number of replications in Monte Carlo simulation.

Details
The test is based on the following statistic:

\[ J_n = \frac{1}{n(n-1)(n-2)} \sum_{i \neq j, k < j} 1\{x_i > x_j + x_k\}. \]

Under exponentiality, one has

\[ \sqrt{n}(J_n - \frac{1}{4}) \xrightarrow{d} N(0, \frac{5432}{4}). \]

(see Hollander and Proshan (1972)).
Value

A list with class "htest" containing the following components:

- **statistic** the value of the test statistic.
- **p.value** the p-value for the test.
- **method** the character string "Hollander-Proshan test for exponentiality".
- **data.name** a character string giving the name(s) of the data.

Author(s)

Alexey Novikov and Ruslan Pusev

References


Examples

```r
hollander.exp.test(rexp(R5))
hollander.exp.test(rgamma(R5LR))
```

kimber.exp.test Kimber-Michael test for exponentiality

Description

Performs Kimber-Michael test for the composite hypothesis of exponentiality, see e.g. Michael (1983), Kimber (1985).

Usage

```r
kimber.exp.test(x, nrepl=2000)
```

Arguments

- **x** a numeric vector of data values.
- **nrepl** the number of replications in Monte Carlo simulation.

Details

The Kimber-Michael test for exponentiality is based on the following statistic:

\[ D = \max_i |r_i - s_i|, \]

where

\[ s_i = \frac{2}{\pi} \arcsin \sqrt{1 - \exp\left(-X(i)/\bar{X}\right)}, \quad r_i = \frac{2}{\pi} \arcsin \sqrt{(i - 0.5)/n}. \]

The p-value is computed by Monte Carlo simulation.
kochar.exp.test

Value
A list with class "htest" containing the following components:

- **statistic**: the value of the Kimber-Michael statistic.
- **p.value**: the p-value for the test.
- **method**: the character string "Kimber-Michael test for exponentiality".
- **data.name**: a character string giving the name(s) of the data.

Author(s)
Alexey Novikov and Ruslan Pusev

References

Examples
kimber.exp.test(rexp(100))
kimber.exp.test(rchisq(100, 2))

kochar.exp.test  Kochar test for exponentiality

Description
Performs Kochar test for the composite hypothesis of exponentiality, see e.g. Kochar (1985).

Usage
kochar.exp.test(x, simulate.p.value=FALSE, nrepl=2000)

Arguments
- **x**: a numeric vector of data values.
- **simulate.p.value**: a logical value indicating whether to compute p-values by Monte Carlo simulation.
- **nrepl**: the number of replications in Monte Carlo simulation.
Details

The Kochar test for exponentiality is based on the following statistic:

\[
T = \sqrt{\frac{108n}{17} \sum_{i=1}^{n} J(i/(n + 1)) X(i)} / \sum_{i=1}^{n} X_i,
\]

where

\[
J(u) = 2(1 - u)[1 - \log (1 - u)] - 1.
\]

The statistic \( T \) is asymptotically standard normal.

Value

A list with class "htest" containing the following components:

- **statistic**: the value of the Kochar statistic.
- **p.value**: the p-value for the test.
- **method**: the character string "Kochar test for exponentiality".
- **data.name**: a character string giving the name(s) of the data.

Author(s)

Alexey Novikov and Ruslan Pusev

References


Examples

```r
kochar.exp.test(rexp(100))
kochar.exp.test(rchisq(100,1))
```

Description

Performs Kolmogorov-Smirnov test for the composite hypothesis of exponentiality, see e.g. Henze and Meintanis (2005, Sec. 2.1).

Usage

```r
ks.exp.test(x, nrepl=2000)
```
Arguments

- **x**: a numeric vector of data values.
- **nrepl**: the number of replications in Monte Carlo simulation.

Details

The Kolmogorov-Smirnov test for exponentiality is based on the following statistic:

\[
KS_n = \sup_{x \geq 0} |F_n(x) - (1 - \exp(-x))|
\]

where \(F_n\) is the empirical distribution function of the scaled data \(Y_j = X_j / X\). The p-value is computed by Monte Carlo simulation.

Value

A list with class "htest" containing the following components:

- **statistic**: the value of the Kolmogorov-Smirnov statistic.
- **p.value**: the p-value for the test.
- **method**: the character string "Kolmogorov-Smirnov test for exponentiality".
- **data.name**: a character string giving the name(s) of the data.

Author(s)

Ruslan Pusev and Maxim Yakovlev

References


Examples

```r
ks.exp.test(rexp(100))
ks.exp.test(runif(100, min = 50, max = 100))
```

Description

Performs Lorenz test for the composite hypothesis of exponentiality, see e.g. Gail and Gastwirth (1978).

Usage

```r
lorenz.exp.test(x, p=0.5, simulate.p.value=FALSE, nrepl=2000)
```
Arguments

- **x**: a numeric vector of data values.
- **p**: a parameter of the test (see below).
- **simulate.p.value**: a logical value indicating whether to compute p-values by Monte Carlo simulation.
- **nrepl**: the number of replications in Monte Carlo simulation.

Details

The Lorenz test for exponentiality is based on the following statistic:

\[ L = \frac{\sum_{i=1}^{np} X(i)}{\sum_{i=1}^{n} X(i)} \]

The statistic \( \sqrt{n}(L - p - (1 - p) \log(1 - p)) \) is asymptotically standard normal.

Value

A list with class "htest" containing the following components:

- **statistic**: the value of the Lorenz statistic.
- **p.value**: the p-value for the test.
- **method**: the character string "Lorenz test for exponentiality".
- **data.name**: a character string giving the name(s) of the data.

Author(s)

Alexey Novikov and Ruslan Pusev

References


Examples

lorenz.exp.test(rexp(100))
lorenz.exp.test(rchisq(100, 7))
Description
Perform Moran test for the composite hypothesis of exponentiality, see e.g. Moran (1951) and Tchirina (2005).

Usage
moran.exp.test(x, simulate.p.value=FALSE, nrepl=2000)

Arguments
- x: a numeric vector of data values.
- simulate.p.value: a logical value indicating whether to compute p-values by Monte Carlo simulation.
- nrepl: the number of replications in Monte Carlo simulation.

Details
The Moran test for exponentiality is based on the following statistic:

\[ T_n^+ = \gamma + \frac{1}{n} \sum_{i=1}^{n} \log \frac{X_i}{\bar{X}}, \]

where \( \gamma \) is Euler-Mascheroni constant. The statistic is asymptotically normal:

\[ \sqrt{n} T_n^+ \rightarrow N \left( 0, \frac{\pi^2}{6} - 1 \right). \]

Value
A list with class "htest" containing the following components:
- statistic: the value of the Moran statistic.
- p.value: the p-value for the test.
- method: the character string "Moran test for exponentiality".
- data.name: a character string giving the name(s) of the data.

Author(s)
Alexey Novikov and Ruslan Pusev
References


Examples

moran.exp.test(rexp(100))
moran.exp.test(rchisq(100,3))

pietra.exp.test

Test for exponentiality based on the Pietra statistic

Description

Performs test for the composite hypothesis of exponentiality based on the Pietra statistic, see e.g. Ascher (1990).

Usage

pietra.exp.test(x, nrepl=2000)

Arguments

x a numeric vector of data values.
nrepl the number of replications in Monte Carlo simulation.

Details

The test is based on the Pietra statistic

$$P_n = \sum_{i=1}^{n} \frac{|X_i - \bar{X}|}{2nX}.$$ 

The p-value is computed by Monte Carlo simulation.

Value

A list with class "htest" containing the following components:

statistic the value of the Pietra statistic.
p.value the p-value for the test.
method the character string "Test for exponentiality based on the Pietra statistic".
data.name a character string giving the name(s) of the data.
**Author(s)**
Ruslan Pusev and Maxim Yakovlev

**References**

**Examples**
```r
pietra.exp.test(rexp(100))
pietra.exp.test(runif(100, min = 50, max = 100))
```

**rossberg.exp.test**  
*Test for exponentiality based on Rossberg characterization*

**Description**
Performs test for the composite hypothesis of exponentiality based on the Rossberg characterization, see Volkova (2010).

**Usage**
```r
rossberg.exp.test(x)
```

**Arguments**
- `x` a numeric vector of data values.

**Details**
The test is based on the following statistic:

\[
S_n = \int_0^{\infty} (H_n(t) - G_n(t))dF_n(t),
\]

where \(F_n\) is the empirical distribution function,

\[
H_n(t) = (C_n^3)^{-1} \sum_{1 \leq i < j < k \leq n} 1\{X_{2,(i,j,k)} - X_{1,(i,j,k)} < t\}, \quad t \geq 0,
\]

\[
G_n(t) = (C_n^2)^{-1} \sum_{1 \leq i < j \leq n} 1\{\min(X_i, X_j) < t\}, \quad t \geq 0.
\]

Here \(X_{s,(i,j,k)}\), \(s = 1, 2\), denotes the \(s\)th order statistic of \(X_i, X_j, X_k\). The p-value is computed from the limit null distribution. Under exponentiality, one has

\[
\sqrt{n}S_n \overset{d}{\rightarrow} N \left(0, \frac{52}{1125}\right)
\]

(see, Volkova (2010)).
Value

A list with class "htest" containing the following components:

- statistic: the value of the test statistic.
- p.value: the p-value for the test.
- method: the character string "Test for exponentiality based on Rossberg characterization".
- data.name: a character string giving the name(s) of the data.

Author(s)

Ruslan Pusev and Maxim Yakovlev

References


Examples

rossberg.exp.test(rexp(25))
rossberg.exp.test(runif(25, min = 50, max = 100))

---

shapiro.exp.test | Shapiro-Wilk test for exponentiality

Description

Performs Shapiro-Wilk test for the composite hypothesis of exponentiality, see e.g. Shapiro and Wilk (1972).

Usage

shapiro.exp.test(x, nrepl=2000)

Arguments

- x: a numeric vector of data values.
- nrepl: the number of replications in Monte Carlo simulation.

Details

The Shapiro-Wilk test for exponentiality is based on the following statistic:

\[ W = \frac{n(X - X_{(1)})^2}{(n - 1) \sum_{i=1}^{n} (X_i - \bar{X})^2}. \]

The p-value is computed by Monte Carlo simulation.
Value

A list with class "htest" containing the following components:

- statistic: the value of the Shapiro-Wilk statistic.
- p.value: the p-value for the test.
- method: the character string "Shapiro-Wilk test for exponentiality".
- data.name: a character string giving the name(s) of the data.

Author(s)

Alexey Novikov and Ruslan Pusev

References


Examples

```r
shapiro.exp.test(rexp(100))
shapiro.exp.test(rchisq(100,1))
```

Description

Performs the WE test for the composite hypothesis of exponentiality, see e.g. Ascher (1990).

Usage

```r
we.exp.test(x, nrepl=2000)
```

Arguments

- `x`: a numeric vector of data values.
- `nrepl`: the number of replications in Monte Carlo simulation.

Details

The test is based on the following statistic

\[ WE = \sum_{i=1}^{n} (X_i - \bar{X})^2 / \left( \sum_{i=1}^{n} X_i \right)^2. \]

The p-value is computed by Monte Carlo simulation.
Value

A list with class "htest" containing the following components:

- statistic: the value of the WE test statistic.
- p.value: the p-value for the test.
- method: the character string "WE test for exponentiality".
- data.name: a character string giving the name(s) of the data.

Author(s)

Ruslan Pusev and Maxim Yakovlev

References


Examples

```r
we.exp.test(rexp(100))
we.exp.test(runif(100, min = 50, max = 100))
```

Description

Performs Wong and Wong test for the composite hypothesis of exponentiality, see e.g. Ascher (1990).

Usage

```r
ww.exp.test(x, nrepl=2000)
```

Arguments

- `x`: a numeric vector of data values.
- `nrepl`: the number of replications in Monte Carlo simulation.

Details

The test is based on the following statistic:

\[ Q = \frac{X_{(n)}}{X_{(1)}}. \]

where \( X_{(1)} \) and \( X_{(n)} \) are the smallest and the largest order statistics respectively. The p-value is computed by Monte Carlo simulation.
Value

A list with class "htest" containing the following components:

- statistic: the value of the statistic of the test.
- p.value: the p-value for the test.
- method: the character string "Wong and Wong test for exponentiality".
- data.name: a character string giving the name(s) of the data.

Author(s)

Ruslan Pusev and Maxim Yakovlev

References


Examples

ww.exp.test(rexp(100))
ww.exp.test(abs(rcauchy(100)))
Index

*Topic htest

ahsanullah.exp.test, 2
atkinson.exp.test, 3
co.exp.test, 4
cvm.exp.test, 6
deshpande.exp.test, 7
ep.exp.test, 8
epstein.exp.test, 9
frozini.exp.test, 10
gini.exp.test, 11
gnedenko.exp.test, 13
harris.exp.test, 14
hegazy1.exp.test, 15
hegazy2.exp.test, 16
hollander.exp.test, 17
kimber.exp.test, 18
kochar.exp.test, 19
ks.exp.test, 20
lorenz.exp.test, 21
moran.exp.test, 23
pietra.exp.test, 24
rossberg.exp.test, 25
shapiro.exp.test, 26
we.exp.test, 27
ww.exp.test, 28

ahsanullah.exp.test, 2
atkinson.exp.test, 3

co.exp.test, 4
cvm.exp.test, 6
deshpande.exp.test, 7
ep.exp.test, 8
epstein.exp.test, 9
frozini.exp.test, 10
gini.exp.test, 11
gnedenko.exp.test, 13
harris.exp.test, 14
hegazy1.exp.test, 15
hegazy2.exp.test, 16
hollander.exp.test, 17
kimber.exp.test, 18
kochar.exp.test, 19
ks.exp.test, 20
lorenz.exp.test, 21
moran.exp.test, 23
pietra.exp.test, 24
rossberg.exp.test, 25
shapiro.exp.test, 26
we.exp.test, 27
ww.exp.test, 28