Package ‘gofIG’

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Type Package

Title Goodness-of-Fit Tests for the Inverse Gaussian Distribution

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Description We implement various tests for the composite hypothesis of testing the fit to the family of inverse Gaussian distributions. Included are methods presented by Allison, J.S., Betsch, S., Ebner, B., and Visagie, I.J.H. (2022) <doi:10.48550/arXiv.1910.14119>, as well as two tests from Henze and Klar (2002) <doi:10.1023/A:1022442506681>. Additionally, the package implements a test proposed by Baringhaus and Gaigall (2015) <doi:10.1016/j.jmva.2015.05.013>. For each test a parametric bootstrap procedure is implemented.

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Contents

ABEV1 *The first Allison-Betsch-Ebner-Visagie test statistic*

Description

This function computes the first test statistic of the goodness-of-fit tests for the inverse Gaussian family due to Allison et al. (2022). Two different estimation procedures are implemented, namely the method of moment and the maximum likelihood method.

Usage

```
ABEV1(data, a = 10, meth = "MME")
```

Arguments

`data`	a vector of positive numbers.
`a`	positive tuning parameter.
`meth`	method of estimation used. Possible values are `'MME'` for moment estimation and `'MLE'` for maximum likelihood estimation.

Details

The numerically stable test statistic for the first Allison-Betsch-Ebner-Visagie test is defined as:

$$ABEV1_{n,a} = \frac{1}{4n} \sum_{j,k=1}^{n} \left(\hat{\varphi}_n + \frac{3}{Y_{n,j}} - \frac{\hat{\varphi}_n}{Y_{n,j}^2} \right) \left(\hat{\varphi}_n + \frac{3}{Y_{n,k}} - \frac{\hat{\varphi}_n}{Y_{n,k}^2} \right) h_{1,a}(Y_{n,j}, Y_{n,k})$$

$$-2 \left(\hat{\varphi}_n + \frac{3}{Y_{n,j}} - \frac{\hat{\varphi}_n}{Y_{n,j}^2} \right) h_{2,a}(Y_{n,j}, Y_{n,k})$$

$$-2\left(\hat{\varphi}_n + \frac{3}{Y_{n,k}} - \frac{\hat{\varphi}_n}{Y_{n,k}^2}\right) h_{2,a}(Y_{n,k}, Y_{n,j})$$

$$+\frac{4}{a}e^{-a\max(Y_{n,j},Y_{n,k})},$$

with $\hat{\varphi}_n = \frac{\hat{\lambda}_n}{\hat{\mu}_n}$, where $\hat{\mu}_n, \hat{\lambda}_n$ are consistent estimators of μ, λ, respectively, the parameters of the inverse Gaussian distribution. Furthermore $Y_{n,j} = \frac{X_j}{\hat{\mu}_n}$, $j = 1, ..., n$, for $(X_j)_{j=1,...,n}$, a sequence of independent observations of a positive random variable X. The functions $h_{i,a}(s,t)$, $i = 1, 2$, are defined in Allison et al. (2022), section 5.1. The null hypothesis is rejected for large values of the test statistic $ABEV1_{n,a}$.

Value

value of the test statistic.

References

Allison, J.S., Betsch, S., Ebner, B., Visagie, I.J.H. (2022) "On Testing the Adequacy of the Inverse Gaussian Distribution". LINK

Examples

```
ABEV1(rmutil::rinvgauss(20,2,1),a=10,meth='MLE')
```

ABEV2 *The second Allison-Betsch-Ebner-Visagie test statistic*

Description

This function computes the second test statistic of the goodness-of-fit tests for the inverse Gaussian family due to Allison et al. (2022). Two different estimation procedures are implemented, namely the method of moment and the maximum likelihood method.

Usage

```
ABEV2(data, a = 10, meth = "MME")
```

Arguments

`data`	a vector of positive numbers.
`a`	positive tuning parameter.
`meth`	method of estimation used. Possible values are `'MME'` for moment estimation and `'MLE'` for maximum likelihood estimation.

Details

The numerically stable test statistic for the second Allison-Betsch-Ebner-Visagie test is defined as:

$$ABEV2_{n,a} = \frac{1}{4n}\sum_{j,k=1}^{n}\left(\hat{\varphi}_n + \frac{3}{Y_{n,j}} - \frac{\hat{\varphi}_n}{Y_{n,j}^2}\right)\left(\hat{\varphi}_n + \frac{3}{Y_{n,k}} - \frac{\hat{\varphi}_n}{Y_{n,k}^2}\right)\tilde{h}_{1,a}(Y_{n,j}, Y_{n,k})$$

$$-2\left(\hat{\varphi}_n + \frac{3}{Y_{n,j}} - \frac{\hat{\varphi}_n}{Y_{n,j}^2}\right)\tilde{h}_{2,a}(Y_{n,j}, Y_{n,k})$$

$$-2\left(\hat{\varphi}_n + \frac{3}{Y_{n,k}} - \frac{\hat{\varphi}_n}{Y_{n,k}^2}\right)\tilde{h}_{2,a}(Y_{n,k}, Y_{n,j})$$

$$+4\frac{\sqrt{\pi}}{a}\Phi\left(-\sqrt{2a}\max(Y_{n,j}, Y_{n,k})\right),$$

with $\hat{\varphi}_n = \frac{\hat{\lambda}_n}{\hat{\mu}_n}$, where $\hat{\mu}_n, \hat{\lambda}_n$ are consistent estimators of μ, λ, respectively, the parameters of the inverse Gaussian distribution. Furthermore $Y_{n,j} = \frac{X_j}{\hat{\mu}_n}$, $j = 1, ..., n$, for $(X_j)_{j=1,...,n}$, a sequence of independent observations of a positive random variable X. The functions $\tilde{h}_{i,a}(s,t)$, $i = 1, 2$, are defined in Allison et al. (2022), section 5.1, and Φ denotes the distribution function of the standard normal distribution. The null hypothesis is rejected for large values of the test statistic $ABEV2_{n,a}$.

Value

value of the test statistic.

References

Allison, J.S., Betsch, S., Ebner, B., Visagie, I.J.H. (2022) "On Testing the Adequacy of the Inverse Gaussian Distribution". LINK

Examples

```
ABEV2(rmutil::rinvgauss(20,2,1),a=10,meth='MLE')
```

AD — *The Anderson-Darling test statistic*

Description

This function computes the test statistic of the goodness-of-fit test for the inverse Gaussian family in the spirit of Anderson and Darling.

Usage

```
AD(data)
```

Arguments

`data` a vector of positive numbers.

Details

Let $X_{(j)}$ denote the jth order statistic of $X_1, \dots, X_n$, a sequence of independent observations of a positive random variable X. Furthermore, let $\hat{F}(x) = F(x; \hat{\mu}_n, \hat{\lambda}_n)$, where F is the distribution function of the inverse Gaussian distribution. Note that $\hat{\mu}_n, \hat{\lambda}_n$ are the maximum likelihood estimators for μ and λ, respectively, the parameters of the inverse Gaussian distribution. The null hypothesis is rejected for large values of the test statistic:

$$AD = -n - \frac{1}{n} \sum_{j=1}^{n} \left[(2j-1) \log \hat{F}(X_{(j)}) + (2(n-j)+1) \log \left(1 - \hat{F}(X_{(j)}) \right) \right].$$

Value

value of the test statistic.

References

Allison, J.S., Betsch, S., Ebner, B., Visagie, I.J.H. (2022) "On Testing the Adequacy of the Inverse Gaussian Distribution". LINK

Examples

```
AD(rmutil::rinvgauss(20,2,1))
```

`BG` *The Baringhaus-Gaigall test statistic*

Description

This function computes the test statistic of the goodness-of-fit test for the inverse Gaussian family due to Baringhaus and Gaigall (2015).

Usage

```
BG(data)
```

Arguments

`data` a vector of positive numbers.

Details

The test statistic of the Baringhaus-Gaigall test is defined as:

$$BG_n = \frac{n}{(n(n-1))^5} \sum_{\mu,\nu=1,\mu\neq\nu}^{n} \left(N_1(\mu,\nu)N_4(\mu,\nu) - N_2(\mu,\nu)N_3(\mu,\nu)\right)^2,$$

where

$$N_1(\mu,\nu) = \sum_{i,j=1,i\neq j}^{n} \mathbf{1}\left\{\tilde{Y}_{i,j} \leq \tilde{Y}_{\mu,\nu}, \tilde{Z}_{i,j} \leq \tilde{Z}_{\mu,\nu}\right\},$$

$$N_2(\mu,\nu) = \sum_{i,j=1,i\neq j}^{n} \mathbf{1}\left\{\tilde{Y}_{i,j} \leq \tilde{Y}_{\mu,\nu}, \tilde{Z}_{i,j} > \tilde{Z}_{\mu,\nu}\right\},$$

$$N_3(\mu,\nu) = \sum_{i,j=1,i\neq j}^{n} \mathbf{1}\left\{\tilde{Y}_{i,j} > \tilde{Y}_{\mu,\nu}, \tilde{Z}_{i,j} \leq \tilde{Z}_{\mu,\nu}\right\},$$

$$N_4(\mu,\nu) = \sum_{i,j=1,i\neq j}^{n} \mathbf{1}\left\{\tilde{Y}_{i,j} > \tilde{Y}_{\mu,\nu}, \tilde{Z}_{i,j} > \tilde{Z}_{\mu,\nu}\right\},$$

with $\mathbf{1}$ being the indicator function. Let $f(X_i, X_j) = (X_i + X_j)/2$ and $g(X_i, X_j) = (X_i^{-1} + X_j^{-1})/2 - f(X_i, X_j)^{-1}$, with $X_1, ..., X_n$ positive, independent and identically distributed random variables with finite moments $\mathbb{E}[X_1^2]$ and $\mathbb{E}[X_1^{-1}]$. Then $(\tilde{Y}_{i,j}, \tilde{Z}_{i,j}) = (f(X_i, X_j), g(X_i, X_j)), 1 \leq i, j \leq n, i \neq j$. Note that $\tilde{Y}_{i,j}$ and $\tilde{Z}_{i,j}$ are independent if, and only if $X_1, ..., X_n$ are realized from an inverse Gaussian distribution.

Value

value of the test statistic.

References

Baringhaus, L. Gaigall, D. (2015). "On an independence test approach to the goodness-of-fit problem", Journal of Multivariate Analysis, 140, 193-208. doi:10.1016/j.jmva.2015.05.013

Examples

```
BG(rmutil::rinvgauss(20,2,1))
```

CM *The Cramer-von Mises test statistic*

Description

This function computes value of the test statistic of the goodness-of-fit test for the inverse Gaussian family in the spirit of Cramer and von Mises. Note that this tests the composite hypothesis of fit to the family of inverse Gaussian distributions.

Usage

```
CM(data)
```

Arguments

`data`	a vector of positive numbers.

Details

Let $X_{(j)}$ denote the jth order statistic of $X_1, \ldots, X_n$, a sequence of independent observations of a positive random variable X. Furthermore, let $\hat{F}(x) = F(x; \hat{\mu}_n, \hat{\lambda}_n)$, where F is the distribution function of the inverse Gaussian distribution. Note that $\hat{\mu}_n, \hat{\lambda}_n$ are the maximum likelihood estimators for μ and λ, respectively, the parameters of the inverse Gaussian distribution. The null hypothesis is rejected for large values of the test statistic:

$$CM = \frac{1}{12n} + \sum_{j=1}^{n} \left(\hat{F}(X_{(j)}) - \frac{2j-1}{2n} \right)^2 .$$

Value

value of the test statistic.

References

Allison, J.S., Betsch, S., Ebner, B., Visagie, I.J.H. (2022) "On Testing the Adequacy of the Inverse Gaussian Distribution". LINK

Examples

```
CM(rmutil::rinvgauss(20,2,1))
```

HK1 *The first Henze-Klar test statistic*

Description

This function computes the first test statistic of the goodness-of-fit test for the inverse Gaussian family due to Henze and Klar (2002).

Usage

```
HK1(data, a = 0)
```

Arguments

data	a vector of positive numbers.
a	positive tuning parameter.

Details

The representation of the first Henze-Klar test statistic used for computation is given by:

$$HK_{n,a}^{(1)} = \frac{\hat{\varphi}_n}{n} \sum_{j,k=1}^{n} \hat{Z}_{jk}^{-1} \left\{ 1 - (Y_j + Y_k) \left(1 + \sqrt{\frac{\pi}{2\hat{Z}_{jk}}} \text{erfce} \left(\sqrt{\frac{\hat{Z}_{jk}}{2}} \right) \right) + \left(1 + \frac{2}{\hat{Z}_{jk}} \right) Y_j Y_k \right\},$$

with $\hat{\varphi}_n = \frac{\hat{\lambda}_n}{\hat{\mu}_n}$, where $\hat{\mu}_n, \hat{\lambda}_n$ are the maximum likelihood estimators for μ and λ, respectively, the parameters of the inverse Gaussian distribution. Furthermore $\hat{Z}_{jk} = \hat{\varphi}_n(Y_j + Y_k + a)$, where $Y_i = \frac{X_i}{\hat{\mu}_n}$ for $(X_i)_{i=1,\ldots,n}$, a sequence of independent observations of a nonnegative random variable X. To ensure numerical stability of the implementation the exponentially scaled complementary error function erfce(x) is used: erfce$(x) = \exp(x^2)$erfc(x), with erfc$(x) = 2\int_x^\infty \exp(-t^2)dt/\pi$. The null hypothesis is rejected for large values of the test statistic $HK_{n,a}^{(1)}$.

Value

value of the test statistic

References

Henze, N. and Klar, B. (2002) "Goodness-of-fit tests for the inverse Gaussian distribution based on the empirical Laplace transform", Annals of the Institute of Statistical Mathematics, 54(2):425-444. doi:10.1023/A:1022442506681

Examples

```
HK1(rmutil::rinvgauss(20,2,1))
```

HK2 *The second Henze-Klar test statistic*

Description

This function computes the test statistic of the second goodness-of-fit test for the inverse Gaussian family due to Henze and Klar (2002).

Usage

```
HK2(data)
```

Arguments

`data`	a vector of positive numbers.

Details

The representation of the second Henze-Klar test statistic used for computation $(a = 0)$ is given by:

$$HK_{n,0}^{(2)} = \frac{1}{n}\sum_{j,k=1}^{n} Z_{jk}^{-1} - 2\sum_{j=1}^{n} Z_j^{-1}\left\{1 - \sqrt{\frac{\pi\hat{\varphi}_n}{2Z_j}}\,\mathrm{erfce}\left(\frac{\hat{\varphi}_n^{1/2}(Z_j+1)}{(2Z_j)^{1/2}}\right)\right\} + n\frac{1+2\hat{\varphi}_n}{4\hat{\varphi}_n}$$

with $\hat{\varphi}_n = \frac{\hat{\lambda}_n}{\hat{\mu}_n}$, where $\hat{\mu}_n, \hat{\lambda}_n$ are the maximum likelihood estimators for μ and λ, respectively, the parameters of the inverse Gaussian distribution. Furthermore $Z_{jk} = (Y_j + Y_k)$ and $Z_j = Y_j$, where $Y_i = \frac{X_i}{\hat{\mu}_n}$ for $(X_i)_{i=1,\ldots,n}$, a sequence of independent observations of a nonnegative random variable X. To ensure numerical stability of the implementation the exponentially scaled complementary error function $\mathrm{erfce}(x)$ is used: $\mathrm{erfce}(x) = \exp(x^2)\mathrm{erfc}(x)$, with $\mathrm{erfc}(x) = 2\int_x^\infty \exp(-t^2)dt/\pi$. The null hypothesis is rejected for large values of the test statistic $HK_{n,a}^{(2)}$.

Value

value of the test statistic.

References

Henze, N. and Klar, B. (2002) "Goodness-of-fit tests for the inverse Gaussian distribution based on the empirical Laplace transform", Annals of the Institute of Statistical Mathematics, 54(2):425-444. doi:10.1023/A:1022442506681

Examples

```
HK2(rmutil::rinvgauss(20,2,1))
```

`KS` *The Kolmogorov-Smirnov test statistic*

Description

This function computes the test statistic of the goodness-of-fit test for the inverse Gaussian family in the spirit of Kolmogorov and Smirnov. Note that this tests the composite hypothesis of fit to the family of inverse Gaussian distributions.

Usage

```
KS(data)
```

Arguments

`data`	a vector of positive numbers.

Details

Let $X_{(j)}$ denote the jth order statistic of $X_1, \ldots, X_n$, a sequence of independent observations of a positive random variable X. Furthermore, let $\hat{F}(x) = F(x; \hat{\mu}_n, \hat{\lambda}_n)$, where F is the distribution function of the inverse Gaussian distribution. Note that $\hat{\mu}_n, \hat{\lambda}_n$ are the maximum likelihood estimators for μ and λ, respectively, the parameters of the inverse Gaussian distribution. The null hypothesis is rejected for large values of the test statistic:

$$KS = \max(D^+, D^-),$$

where

$$D^+ = \max_{j=1,\ldots,n} \left(\frac{j}{n} - \hat{F}(X_{(j)}) \right)$$

and

$$D^- = \max_{j=1,\ldots,n} \left(\hat{F}(X_{(j)}) - \frac{j-1}{n} \right).$$

Value

value of the test statistic.

References

Allison, J.S., Betsch, S., Ebner, B., Visagie, I.J.H. (2022) "On Testing the Adequacy of the Inverse Gaussian Distribution". LINK

Examples

```
KS(rmutil::rinvgauss(20,2,1))
```

print.gofIG — *Print method for tests of the inverse Gaussian distribution*

Description

Printing objects of class "gofIG".

Usage

```
## S3 method for class 'gofIG'
print(x, ...)
```

Arguments

x	object of class "gofIG".
...	further arguments to be passed to or from methods.

Details

A `gofIG` object is a named list of numbers and character string, supplemented with `test` (the name of the teststatistic). `test` is displayed as a title. The remaining elements are given in an aligned "name = value" format.

Value

the argument x, invisibly, as for all print methods.

Examples

```
print(test.ABEV1(rgamma(20,1)))
```

test.ABEV1 — *The first Allison-Betsch-Ebner-Visagie goodness-of-fit test for the inverse Gaussian family*

Description

This function computes the goodness-of-fit test for the inverse Gaussian family due to Allison et al. (2019). Two different estimation procedures are implemented, namely the method of moment and the maximum likelihood method.

Usage

```
test.ABEV1(data, a = 10, meth = "MME", B = 500)
```

Arguments

`data`	a vector of positive numbers.
`a`	positive tuning parameter.
`meth`	method of estimation used. Possible values are `'MME'` for moment estimation and `'MLE'` for maximum likelihood estimation.
`B`	number of bootstrap iterations used to obtain p value.

Details

The test is of weighted L^2 type and uses a characterization of the distribution function of the inverse Gaussian distribution. The p value is obtained by a parametric bootstrap procedure.

Value

a list containing the value of the name of the test statistic, the used tuning parameter, the parameter estimation method, the value of the test statistic, the bootstrap p value, the values of the estimators, and the number of bootstrap iterations:

`$Test` the name of the used test statistic.

`$parameter` the value of the tuning parameter.

`$est.method` the estimation method used.

`$T.value` the value of the test statistic.

`$p.value` the approximated p value.

`$par.est` the estimated parameters.

`$boot.run` number of bootstrap iterations.

References

Allison, J.S., Betsch, S., Ebner, B., Visagie, I.J.H. (2019) "New weighted L^2-type tests for the inverse Gaussian distribution", arXiv:1910.14119. LINK

Examples

```
test.ABEV1(rmutil::rinvgauss(20,2,1),B=100)
```

`test.ABEV2` *The second Allison-Betsch-Ebner-Visagie goodness-of-fit test for the inverse Gaussian family*

Description

This function computes the goodness-of-fit test for the inverse Gaussian family due to Allison et al. (2019). Two different estimation procedures are implemented, namely the method of moment and the maximum likelihood method.

Usage

```
test.ABEV2(data, a = 10, meth = "MME", B = 500)
```

Arguments

`data`	a vector of positive numbers.
`a`	positive tuning parameter.
`meth`	method of estimation used. Possible values are `'MME'` for moment estimation and `'MLE'` for maximum likelihood estimation.
`B`	number of bootstrap iterations used to obtain p value.

Details

The test is of weighted L^2 type and uses a characterization of the distribution function of the inverse Gaussian distribution. The p value is obtained by a parametric bootstrap procedure.

Value

a list containing the value of the name of the test statistic, the used tuning parameter, the parameter estimation method, the value of the test statistic, the bootstrap p value, the values of the estimators, and the number of bootstrap iterations:

`$Test` the name of the used test statistic.

`$parameter` the value of the tuning parameter.

`$est.method` the estimation method used.

`$T.value` the value of the test statistic.

`$p.value` the approximated p value.

`$par.est` the estimated parameters.

`$boot.run` number of bootstrap iterations.

References

Allison, J.S., Betsch, S., Ebner, B., Visagie, I.J.H. (2019) "New weighted L^2-type tests for the inverse Gaussian distribution", arXiv:1910.14119. LINK

Examples

```
test.ABEV2(rmutil::rinvgauss(20,2,1),B=100)
```

`test.AD` *The Anderson-Darling goodness-of-fit test for the inverse Gaussian family*

Description

This function computes the goodness-of-fit test for the inverse Gaussian family in the spirit of Anderson and Darling. Note that this tests the composite hypothesis of fit to the family of inverse Gaussian distributions, i.e. a bootstrap procedure is implemented to perform the test.

Usage

```
test.AD(data, B = 500)
```

Arguments

`data`	a vector of positive numbers.
`B`	number of bootstrap iterations used to obtain p value.

Details

The Anderson-Darling test is computed as described in Allison et. al. (2019). The p value is obtained by a parametric bootstrap procedure.

Value

a list containing the value of the name of the test statistic, the value of the test statistic, the bootstrap p value, the values of the estimators, and the number of bootstrap iterations:

`$Test` the name of the used test statistic.

`$T.value` the value of the test statistic.

`$p.value` the approximated p value.

`$par.est` the estimated parameters.

`$boot.run` number of bootstrap iterations.

References

Allison, J.S., Betsch, S., Ebner, B., Visagie, I.J.H. (2019) "New weighted L^2-type tests for the inverse Gaussian distribution", arXiv:1910.14119. LINK

Examples

```
test.AD(rmutil::rinvgauss(20,2,1),B=100)
```

`test.BG` *The Baringhaus-Gaigall goodness-of-fit test for the inverse Gaussian family*

Description

This function computes the goodness-of-fit test for the inverse Gaussian family due to Baringhaus and Gaigall (2015).

Usage

```
test.BG(data, B)
```

Arguments

`data`	a vector of positive numbers.
`B`	number of bootstrap iterations used to obtain p value.

Value

a list containing the value of the name of the test statistic, the used tuning parameter, the parameter estimation method, the value of the test statistic, the bootstrap p value, the values of the estimators, and the number of bootstrap iterations:

`$Test` the name of the used test statistic.

`$T.value` the value of the test statistic.

`$p.value` the approximated p value.

`$par.est` the estimated parameters.

`$boot.run` number of bootstrap iterations.

References

Baringhaus, L. Gaigall, D. (2015). "On an independence test approach to the goodness-of-fit problem", Journal of Multivariate Analysis, 140, 193-208. doi:10.1016/j.jmva.2015.05.013

Examples

```
test.BG(rmutil::rinvgauss(20,2,1),B=100)
```

`test.CM` *The Cramer-von Mises goodness-of-fit test for the inverse Gaussian family*

Description

This function computes the goodness-of-fit test for the inverse Gaussian family in the spirit of Cramer and von Mises. Note that this tests the composite hypothesis of fit to the family of inverse Gaussian distributions, i.e. a bootstrap procedure is implemented to perform the test.

Usage

```
test.CM(data, B = 500)
```

Arguments

`data`	a vector of positive numbers.
`B`	number of bootstrap iterations used to obtain p value.

Details

The Cramer-von Mises test is computed as described in Allison et. al. (2019). The p value is obtained by a parametric bootstrap procedure.

Value

a list containing the value of the name of the test statistic, the value of the test statistic, the bootstrap p value, the values of the estimators, and the number of bootstrap iterations:

`$Test` the name of the used test statistic.

`$T.value` the value of the test statistic.

`$p.value` the approximated p value.

`$par.est` the estimated parameters.

`$boot.run` number of bootstrap iterations.

References

Allison, J.S., Betsch, S., Ebner, B., Visagie, I.J.H. (2019) "New weighted L^2-type tests for the inverse Gaussian distribution", arXiv:1910.14119. LINK

Examples

```
test.CM(rmutil::rinvgauss(20,2,1),B=100)
```

`test.HK1` *The first Henze-Klar goodness-of-fit test for the inverse Gaussian family*

Description

This function computes the goodness-of-fit test for the inverse Gaussian family due to Henze and Klar (2002).

Usage

```
test.HK1(data, a = 0, B = 500)
```

Arguments

`data`	a vector of positive numbers.
`a`	positive tuning parameter.
`B`	number of bootstrap iterations used to obtain p value.

Details

The test statistics is a weighted integral over the squared modulus of some measure of deviation of the empirical distribution of given data from the family of inverse Gaussian laws, expressed by means of the empirical Laplace transform.

Value

a list containing the value of the name of the test statistic, the used tuning parameter, the parameter estimation method, the value of the test statistic, the bootstrap p value, the values of the estimators, and the number of bootstrap iterations:

`$Test` the name of the used test statistic.

`$parameter` the value of the tuning parameter.

`$T.value` the value of the test statistic.

`$p.value` the approximated p value.

`$par.est` the estimated parameters.

`$boot.run` number of bootstrap iterations.

References

Henze, N. and Klar, B. (2002) "Goodness-of-fit tests for the inverse Gaussian distribution based on the empirical Laplace transform", Annals of the Institute of Statistical Mathematics, 54(2):425-444. doi:10.1023/A:1022442506681

Examples

```
test.HK1(rmutil::rinvgauss(20,2,1),B=100)
```

`test.HK2` *The second Henze-Klar goodness-of-fit test for the inverse Gaussian family*

Description

This function computes the goodness-of-fit test for the inverse Gaussian family due to Henze and Klar (2002).

Usage

```
test.HK2(data, B)
```

Arguments

`data`	a vector of positive numbers.
`B`	number of bootstrap iterations used to obtain p value.

Details

The test statistic is a weighted integral over the squared modulus of some measure of deviation of the empirical distribution of given data from the family of inverse Gaussian laws, expressed by means of the empirical Laplace transform.

Value

a list containing the value of the name of the test statistic, the used tuning parameter, the parameter estimation method, the value of the test statistic, the bootstrap p value, the values of the estimators, and the number of bootstrap iterations:

`$Test` the name of the used test statistic.

`$T.value` the value of the test statistic.

`$p.value` the approximated p value.

`$par.est` the estimated parameters.

`$boot.run` number of bootstrap iterations.

References

Henze, N. and Klar, B. (2002) "Goodness-of-fit tests for the inverse Gaussian distribution based on the empirical Laplace transform", Annals of the Institute of Statistical Mathematics, 54(2):425-444. doi:10.1023/A:1022442506681

Examples

```
test.HK2(rmutil::rinvgauss(20,2,1),B=100)
```

`test.KS` *The Kolmogorov-Smirnov goodness-of-fit test for the inverse Gaussian family*

Description

This function computes the goodness-of-fit test for the inverse Gaussian family in the spirit of Kolmogorov and Smirnov. Note that this tests the composite hypothesis of fit to the family of inverse Gaussian distributions, i.e. a bootstrap procedure is implemented to perform the test.

Usage

```
test.KS(data, B = 500)
```

Arguments

`data`	a vector of positive numbers.
`B`	number of bootstrap iterations used to obtain p value.

Details

The Kolmogorov Smirnov test is computed as described in Allison et. al. (2019). The p value is obtained by a parametric bootstrap procedure.

Value

a list containing the value of the name of the test statistic, the value of the test statistic, the bootstrap p value, the values of the estimators, and the number of bootstrap iterations:

`$Test` the name of the used test statistic.

`$T.value` the value of the test statistic.

`$p.value` the approximated p value.

`$par.est` the estimated parameters.

`$boot.run` number of bootstrap iterations.

References

Allison, J.S., Betsch, S., Ebner, B., Visagie, I.J.H. (2019) "New weighted L^2-type tests for the inverse Gaussian distribution", arXiv:1910.14119. LINK

Examples

```
test.KS(rmutil::rinvgauss(20,2,1),B=100)
```

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