

Package ‘symtests’

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Type Package

Title Symmetry Tests for Univariate Data

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Description Implements statistical tests for detecting departures from symmetry in univariate data, including procedures based on moments, spacings, order statistics, and triples. The functions provide straightforward tools for assessing symmetry in empirical distributions.

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es_symtest

*ES symmetry test***Description**

Performs the ES symmetry test by Ekström & Jammalamadaka (2007).

Usage

```
es_symtest(x)
```

Arguments

x A numeric vector.

Details

Let $x_{(1)} \leq \dots \leq x_{(n)}$ denote the ordered sample, and let $D_i = x_{(i+1)} - x_{(i)}$ be the successive spacings.

The test uses

$$S = n^{-1/2} \sum_{i=1}^{[(n-1)/2]} \left(I(D_i - D_{n-i} \leq 0) - \frac{1}{2} \right),$$

together with a variance estimate based on spacings of order $2m-1$, where $m = 3$ if $n < 200$ and $m = 4$ otherwise.

The resulting test statistic is

$$T = \frac{S}{\hat{\sigma}},$$

where $\hat{\sigma}^2$ is an estimator of the asymptotic variance of S . The p -value is computed using a Student's t approximation.

Value

An object of class "htest" with the following components:

statistic The value of the test statistic.

p.value The p -value of the test.

References

Ekström, M., & Jammalamadaka, R. S. (2007). An asymptotically distribution-free test of symmetry. *Journal of Statistical Planning and Inference*, 137(3), 799–810. doi:10.1016/j.jspi.2006.06.009

See Also

[triples_symtest\(\)](#), [tail_symtest\(\)](#), [gupta_symtest\(\)](#),
[lawstat::symmetry.test\(\)](#), [symmetry::symmetry_test\(\)](#)

Examples

```
set.seed(123)
es_symtest(rnorm(100))

set.seed(123)
es_symtest(rexp(100))
```

gupta_symtest

*Gupta symmetry test***Description**

Performs the test of symmetry by Gupta (1967) based on the standardized third central moment and its asymptotic variance.

Usage

```
gupta_symtest(x)
```

Arguments

x A numeric vector.

Details

The test is based on the sample skewness measure

$$b_1 = \frac{m_3}{m_2^{3/2}},$$

where $m_r = \frac{1}{n} \sum_{i=1}^n (x_i - \bar{x})^r$.

The test statistic is

$$Z = \sqrt{n} \frac{b_1}{\sigma},$$

where

$$\sigma = \sqrt{\frac{m_6 - 6m_2m_4 + 9m_2^3}{m_2^3}}.$$

For distributions with zero skewness and finite moments up to order six, the test statistic converges in distribution to a standard normal distribution, $N(0,1)$.

Value

An object of class "htest" with the following components:

statistic The value of the test statistic.

p.value The two-sided p -value.

References

Gupta, M. K. (1967). An asymptotically nonparametric test of symmetry. *The Annals of Mathematical Statistics*, **38**(3), 849–866.

See Also

[triples_symtest\(\)](#), [tail_symtest\(\)](#), [es_symtest\(\)](#),
[lawstat::symmetry.test\(\)](#), [symmetry::symmetry_test\(\)](#)

Examples

```
x <- c(-3, -2, -1, 0, 1, 2, 3)
gupta_symtest(x)

y <- c(1, 2, 2, 3, 4, 10, 25)
gupta_symtest(y)
```

tail_symtest	<i>Tail-based symmetry test</i>
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Description

Performs a tail-based symmetry test by comparing spacings in the lower and upper tails of the ordered sample.

Usage

```
tail_symtest(x, alpha = NULL)
```

Arguments

x	A numeric vector.
alpha	Optional significance level used to select the tuning value b , which determines the number of spacings averaged in each tail. Allowed values are NULL, 0.05, or 0.10. By default (alpha=NULL), the generalized version of the test is used with $b = 0.27$, which performs reasonably well for significance levels between 0.05 and 0.1. When alpha=0.05 or 0.1, calibrated values $b = 0.26$ and $b = 0.28$ are used, respectively.

Details

Let $x_{(1)} \leq \dots \leq x_{(n)}$ denote the ordered sample, and define the spacings $D_i = x_{(i+1)} - x_{(i)}$, $i = 1, \dots, n-1$. For a tuning value b , let $k = \lceil bn \rceil$ denote the number of spacings averaged in each tail, where $\lceil \cdot \rceil$ is the ceiling function. The test statistic is defined as a standardized difference between the average lower- and upper-tail spacings,

$$T = \frac{\sum_{i=1}^k D_{n-i} - \sum_{i=1}^k D_i}{s_D \sqrt{2k}}$$

where s_D is the sample standard deviation of spacings. The two-sided p -value is computed using the standard normal approximation.

For a nominal significance level of $\alpha=0.05$, the value $b = 0.26$ provides the best calibration, whereas for $\alpha=0.10$, $b = 0.28$ is preferred. The default choice $b = 0.27$ provides reasonably good performance across significance levels between 0.05 and 0.10 , avoiding the need to recalibrate the tuning value for each significance level. Because the test is based on tail spacings, it may have low power against alternatives where departures from symmetry are confined to the center of the distribution.

Value

An object of class `htest` containing:

statistic the test statistic

p.value the two-sided p -value

n the number of observations in the sample

b the tuning value used in the test

k the number of spacings averaged in each tail, computed as $\lceil bn \rceil$

References

Molera, L., and Parra-Frutos, I. (2026). A Symmetry Test based on Tail Spacings. Manuscript submitted for publication.

See Also

[triples_symtest\(\)](#), [es_symtest\(\)](#), [gupta_symtest\(\)](#), [lawstat::symmetry.test\(\)](#), [symmetry::symmetry_test\(\)](#)

Examples

```
set.seed(123)
x <- rnorm(100)
tail_symtest(x)
tail_symtest(x, alpha = 0.10)
tail_symtest(rexp(60, 1))
```

triples_symtest	<i>Triples symmetry test</i>
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Description

Performs the test of symmetry by Randles et al. (1980).

Usage

```
triples_symtest(x)
```

Arguments

x A numeric vector of observations.

Details

The test is based on a standardized U-statistic that compares the numbers of sample triples skewed to the right and to the left. The p -value is computed using a Student's t approximation with n degrees of freedom, where n is the sample size. Since all possible triples are considered, computation may be slow for large samples.

Value

An object of class "htest" with the following components:

statistic The value of the test statistic.

parameter The degrees of freedom used in the t approximation.

p.value The two-sided p -value for the null hypothesis of symmetry.

References

Randles, R. H., Fligner, M. A., Policello, G. E., and Wolfe, D. A. (1980). "An asymptotically distribution-free test for symmetry versus asymmetry." *Journal of the American Statistical Association*, 75, 168–172.

See Also

[tail_symtest\(\)](#), [es_symtest\(\)](#), [gupta_symtest\(\)](#),
[lawstat::symmetry.test\(\)](#), [symmetry::symmetry_test\(\)](#)

Examples

```
set.seed(123)
x <- rnorm(20)
triples_symtest(x)
```

```
y <- rexp(20) - 1
triples_symtest(y)
```

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