Package 'RobustBF'

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Type Package

Title Robust Solution to the Behrens-Fisher Problem

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Description Robust tests (RW and RF) are provided for testing the equality of two long-tailed symmetric (LTS) means when the variances are unknown and arbitrary. RW test is a robust version of Welch's two sample t test and the RF is a robust fiducial based test. The RW and RF tests are proposed using the adaptive modified maximum likelihood (AMML) estimators derived by Tiku and Surucu (2009) <doi:10.1016/j.spl.2008.12.001> and Donmez (2010) <https://open.metu.edu.tr/bitstream/handle/11511/19440/index.pdf>.

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Imports stats

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NeedsCompilation no

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R topics documented:

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RF   *Robust Fiducial Based Test*

Description

Computes p-value for the robust fiducial (RF) based test for the equality of means of two long-tailed symmetric (LTS) distributions when the variances are not equal.

Usage

```
RF(y1, y2, iter=5000)
```

Arguments

y1	numeric vector of sample 1
y2	numeric vector of sample 2
iter	the number of iterations for perfoming the RF test.

Details

RF test based on adaptive modified maximum likelihood (AMML) estimators (Tiku and Surucu, 2009; Donmez, 2010) is proposed using the fiducial model which is a special case of functional model given by Dawid and Stone (1982), see also Fisher (1933, 1935) for more information about the fiducial approach. It is one of the alternatives of Welch's t test (Welch, 1938) and its p-value is based on the iteration number. For further details, see Guven et al. (2021).

Value

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

p.value	the p-value for the RF test.
estimate	the AMML estimates of the location and scale parameters.
null.value	the specified hypothesized value of the mean difference.
alternative	a character string describing the alternative hypothesis.
method	a character string indicating which test is used.
data.name	a character string giving the name(s) of the data.

Author(s)

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References

Dawid, A. P. and Stone, M. (1982). The functional-model basis of fiducial inference. The Annals of Statistics, 10(4):1054-1067.

Fisher, R. A. (1933). The concepts of inverse probability and fiducial probability referring to unknown parameters. Proceedings of Royal Society of London. Series A, 139(838):343-348

Fisher, R. A. (1935). The fiducial argument in statistical inference. Annals of eugenics, 6(4):391-398

Guven, G., Acitas, S., Samkar, H., Senoglu, B. (2021). RobustBF: An R Package for Robust Solution to the Behrens-Fisher Problem. RJournal (submitted).

Tiku, M. L. and Surucu, B. (2009). MMLEs are as good as M-estimators or better. Statistics & probability letters, 79(7):984-989.

Welch, B.L. (1938). The significance of the difference between two means when the population variances are unequal. Biometrika, 29(3/4):350–362.

Examples

```
# The following two samples (y1 and y2)
# come from LTS distributions with
# heterogeneous variances

y1 <- c(0.55, 1.39, 2.01, 0.41, 0.32, -0.31, -1.06, -0.84,
        1.02, 0.02, -0.96, 0.18, 0.49, 0.03, 0.77,  0.02,
        0.56,  0.46, -0.65, -0.27)
y2 <- c(7.25, 7.98, -0.24, 8.93, -0.16, 32.28,  3.81,
        2.32, 14.73, 6.27, 8.07,  7.24,  7.18,  3.75, 11.48,
        6.46, 1.01, 5.35, -0.34,  4.34)

# RF test
RF(y1, y2,5000)
```

RW | *Robust Welch's Two Sample t-Test*

Description

Performs robust Welch's (RW) two sample t-test to test the equality of means of two long-tailed symmetric (LTS) distributions when the variances are not equal.

Usage

```
RW(y1, y2)
```

Arguments

y1	numeric vector of sample 1
y2	numeric vector of sample 2

Details

RW test based on adaptive modifed maximum likelihood (AMML) estimators is proposed as a robust alternative to Welch's t-test (Welch, 1938). The test statistic is formulated as follows

$$RW = \frac{(\hat{\mu}_1 - \hat{\mu}_2) - (\mu_1 - \mu_2)}{\sqrt{(\hat{\sigma}_1^2/M_1) + (\hat{\sigma}_2^2/M_2)}}.$$

where $\hat{\mu}_i$ and $\hat{\sigma}_i$ are the AMML estimators of the location and scale parameters $(i, = 1, 2)$, see e.g. Tiku and Surucu (2009), Donmez (2010).

The null distribution of RW is approximately distributed as Student's t with degrees of freedom

$$df = \frac{((\hat{\sigma}_1^2/M_1) + (\hat{\sigma}_2^2/M_2))^2}{(\hat{\sigma}_1^2/M_1)^2/(n_1 - 1) + (\hat{\sigma}_2^2/M_2)^2/(n_2 - 1)}.$$

For further details, see Guven et al. (2021)

Value

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

statistic	the value of the robust Welch's two sample t-test.
parameter	the degrees of freedom for the robust Welch's two sample t-test.
p.value	the p-value for the robust Welch's two sample t-test.
estimate	the AMML estimates of the location and scale parameters.
null.value	the specified hypothesized value of the mean difference.
alternative	a character string describing the alternative hypothesis.
method	a character string indicating which test is used.
data.name	a character string giving the name(s) of the data.

Author(s)

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References

Donmez, A. (2010). Adaptive estimation and hypothesis testing methods [dissertation]. Ankara:METU.

Guven, G., Acitas, S., Samkar, H., Senoglu, B. (2021). RobustBF: An R Package for Robust Solution to the Behrens-Fisher Problem. RJournal (submitted).

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        0.56,  0.46, -0.65, -0.27)
y2 <- c(7.25, 7.98, -0.24, 8.93, -0.16, 32.28,  3.81,
        2.32, 14.73, 6.27, 8.07,  7.24,  7.18,  3.75, 11.48,
        6.46, 1.01, 5.35, -0.34,  4.34)

# RW test
RW(y1, y2)
```

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