Package 'onewaytests'

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Type Package

Title One-Way Tests in Independent Groups Designs

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Suggests AID, tibble

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Description Performs one-way tests in independent groups designs; one-way analysis of variance (ANOVA), Welch's heteroscedastic F test, Welch's heteroscedastic F test with trimmed means and Winsorized variances, Brown-Forsythe test, Alexander-Govern test, James second order test, Kruskal-Wallis test, Scott-Smith test, Box F test and Johansen F test. The package performs pairwise comparisons and graphical approaches. Also, the package includes Student's t test, Welch's t test and Mann-Whitney U test for two samples. Moreover, it assesses variance homogeneity and normality of data in each group via tests and plots (Dag et al., 2018, <https://journal.r-project.org/archive/2018/RJ-2018-022/RJ-2018-022.pdf>).

License GPL (>= 2)

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R topics documented:

`onewaytests-package` *One-Way Tests in Independent Groups Designs*

Description

Performs one-way tests in independent groups designs; one-way analysis of variance (ANOVA), Welch's heteroscedastic F test, Welch's heteroscedastic F test with trimmed means and Winsorized variances, Brown-Forsythe test, Alexander-Govern test, James second order test, Kruskal-Wallis test, Scott-Smith test, Box F test and Johansen F test. The package performs pairwise comparisons and graphical approaches. Also, the package includes Student's t test, Welch's t test and Mann-Whitney U test for two samples. Moreover, it assesses variance homogeneity and normality of data in each group via tests and plots (Dag et al., 2018, <https://journal.r-project.org/archive/2018/RJ-2018-022/RJ-2018-022.pdf>).

Details

Package:	onewaytests
Type:	Package
License:	GPL (>=2)

`ag.test` *Alexander-Govern Test*

Description

`ag.test` performs Alexander-Govern test.

Usage

```
ag.test(formula, data, alpha = 0.05, na.rm = TRUE, verbose = TRUE)
```

Arguments

formula	a formula of the form lhs ~ rhs where lhs gives the sample values and rhs the corresponding groups.
data	a tibble or data frame containing the variables in the formula formula
alpha	the level of significance to assess the statistical difference. Default is set to alpha = 0.05.
na.rm	a logical value indicating whether NA values should be stripped before the computation proceeds.
verbose	a logical for printing output to R console.

Value

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

statistic	the Alexander-Govern test statistic.
parameter	the parameter(s) of the approximate chi-squared distribution of the test statistic.
p.value	the p-value of the test.
alpha	the level of significance to assess the statistical difference.
method	the character string "Alexander-Govern Test".
data	a data frame containing the variables in which NA values (if exist) are removed.
formula	a formula of the form lhs ~ rhs where lhs gives the sample values and rhs the corresponding groups.

Note

An R implementation of Alexander-Govern test has been available since 2007 (written by Sven Hartenstein). The website link is here.

Author(s)

Osman Dag

References

Dag, O., Dolgun, A., Konar, N.M. (2018). onewaytests: An R Package for One-Way Tests in Independent Groups Designs. *The R Journal*, **10:1**, 175-199.

Schneider, P. J., Penfield, D. A. (1997). Alexander and Govern's Approximation: Providing an Alternative to ANOVA Under Variance Heterogeneity. *The Journal of Experimental Education*, **65:3**, 271-286.

Examples

```
######

library(onewaytests)

ag.test(Sepal.Length ~ Species, data = iris)

out <- ag.test(Sepal.Length ~ Species, data = iris)
paircomp(out)

######

library(onewaytests)
library(tibble)

iris <- as_tibble(iris)
ag.test(Sepal.Length ~ Species, data = iris)

out <- ag.test(Sepal.Length ~ Species, data = iris)
paircomp(out)

######
```

---

aov.test *One-Way Analysis of Variance*

Description

`aov.test` performs one-way analysis of variance (ANOVA).

Usage

```
aov.test(formula, data, alpha = 0.05, na.rm = TRUE, verbose = TRUE)
```

Arguments

`formula`	a formula of the form `lhs ~ rhs` where `lhs` gives the sample values and `rhs` the corresponding groups.
`data`	a tibble or data frame containing the variables in the formula `formula`
`alpha`	the level of significance to assess the statistical difference. Default is set to alpha = 0.05.
`na.rm`	a logical value indicating whether NA values should be stripped before the computation proceeds.
`verbose`	a logical for printing output to R console.

Value

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

`statistic`	the analysis of variance test statistic.
`parameter`	the parameter(s) of the approximate F distribution of the test statistic.
`p.value`	the p-value of the test.
`alpha`	the level of significance to assess the statistical difference.
`method`	the character string "One-Way Analysis of Variance".
`data`	a data frame containing the variables in which NA values (if exist) are removed.
`formula`	a formula of the form `lhs ~ rhs` where `lhs` gives the sample values and `rhs` the corresponding groups.

Author(s)

Osman Dag

References

Dag, O., Dolgun, A., Konar, N.M. (2018). onewaytests: An R Package for One-Way Tests in Independent Groups Designs. *The R Journal*, **10:1**, 175-199.

Sheskin, D. J. (2004). *Handbook of Parametric and Nonparametric Statistical Procedures*. 3rd Edition. Chapman and Hall CRC. Florida: Boca Raton.

Examples

```
library(onewaytests)

aov.test(Sepal.Length ~ Species, data = iris)

out <- aov.test(Sepal.Length ~ Species, data = iris)
paircomp(out)
```

---

bf.test *Brown-Forsythe Test*

Description

`bf.test` performs Brown-Forsythe test.

Usage

```
bf.test(formula, data, alpha = 0.05, na.rm = TRUE, verbose = TRUE)
```

Arguments

formula	a formula of the form lhs ~ rhs where lhs gives the sample values and rhs the corresponding groups.
data	a tibble or data frame containing the variables in the formula formula
alpha	the level of significance to assess the statistical difference. Default is set to alpha = 0.05.
na.rm	a logical value indicating whether NA values should be stripped before the computation proceeds.
verbose	a logical for printing output to R console.

Value

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

statistic	the Brown-Forsythe test statistic.
parameter	the parameter(s) of the approximate F distribution of the test statistic.
p.value	the p-value of the test.
alpha	the level of significance to assess the statistical difference.
method	the character string "Brown-Forsythe Test".
data	a data frame containing the variables in which NA values (if exist) are removed.
formula	a formula of the form lhs ~ rhs where lhs gives the sample values and rhs the corresponding groups.

Author(s)

Osman Dag

References

Brown, M. B., Forsythe. A. B. (1974a). The small sample behavior of some statistics which test the equality of several means. *Technometrics*, **16**, 129-132.

Dag, O., Dolgun, A., Konar, N.M. (2018). onewaytests: An R Package for One-Way Tests in Independent Groups Designs. *The R Journal*, **10:1**, 175-199.

Examples

```
library(onewaytests)

bf.test(Sepal.Length ~ Species, data = iris)

out <- bf.test(Sepal.Length ~ Species, data = iris)
paircomp(out)
```

box.test *Box F Test*

Description

box.test performs Box F test.

Usage

```
box.test(formula, data, alpha = 0.05, na.rm = TRUE, verbose = TRUE)
```

Arguments

formula	a formula of the form lhs ~ rhs where lhs gives the sample values and rhs the corresponding groups.
data	a tibble or data frame containing the variables in the formula formula
alpha	the level of significance to assess the statistical difference. Default is set to alpha = 0.05.
na.rm	a logical value indicating whether NA values should be stripped before the computation proceeds.
verbose	a logical for printing output to R console.

Value

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

statistic	the Box F test statistic.
parameter	the parameter(s) of the approximate F distribution of the test statistic.
p.value	the p-value of the test.
alpha	the level of significance to assess the statistical difference.
method	the character string "Box F Test".
data	a data frame containing the variables in which NA values (if exist) are removed.
formula	a formula of the form lhs ~ rhs where lhs gives the sample values and rhs the corresponding groups.

Author(s)

Osman Dag

References

Box, G.E.P. (1954). Some Theorems on Quadratic Forms Applied in the Study of Analysis of Variance Problems, *Annals of Mathematical Statistics*, **25**, 290-302.

Examples

```
library(onewaytests)

johansen.test(Sepal.Length ~ Species, data = iris)

out <- box.test(Sepal.Length ~ Species, data = iris)
paircomp(out)
```

`describe` *Descriptive Statistics*

Description

`describe` produces basic descritive statistics including sample size, mean, standard deviation, median, minimum value, maximum value, 25th quantile, 75th quantile, skewness, kurtosis, the number of missing value.

Usage

```
describe(formula, data)
```

Arguments

`formula`	a formula of the form `lhs ~ rhs` where `lhs` gives the sample values and `rhs` the corresponding groups.
`data`	a tibble or data frame containing the variables in the formula `formula`

Value

Returns a data.frame of output.

Author(s)

Osman Dag

Examples

```
library(onewaytests)

describe(Sepal.Length ~ Species, data = iris)
```

gplot *Box-and-Whisker Plots and Error Bars*

Description

gplot produce box-and-whisker plots and error bars of the given grouped values.

Usage

```
gplot(formula, data, type = c("boxplot", "errorbar"), violin = TRUE, xlab = NULL,
  ylab = NULL, title = NULL, width = NULL, option = c("se", "sd"), na.rm = TRUE)
```

Arguments

formula	a formula of the form lhs ~ rhs where lhs gives the sample values and rhs the corresponding groups.
data	a tibble or data frame containing the variables in the formula formula
type	a character string to select one of the plots. "boxplot": box-and-whisker plot, "errorbar": error bar.
violin	a logical adding violin plot on box-and-whisker plot.
xlab	a label for the x axis, defaults to a description of x.
ylab	a label for the y axis, defaults to a description of y.
title	a main title for the plot.
width	a numeric giving the width of the boxes for box-and-whisker plots (defaults to 0.3) and the width of the little lines at the tops and bottoms of the error bars (defaults to 0.15).
option	a character string to select one of the options to draw error bars with standard error or standard deviation. "se": standard error, "sd": standard deviation. Defaults to "se".
na.rm	a logical indicating whether NA values should be stripped before the computation proceeds.

Details

The upper whisker of box-and-whisker plots extends from the hinge to the highest value that is within 1.5 * IQR of the hinge, where IQR is the inter-quartile range. The lower whisker extends from the hinge to the lowest value within 1.5 * IQR of the hinge. Data out of the ends of the whiskers are outliers and plotted as points.

Author(s)

Osman Dag

See Also

geom_boxplot geom_violin

Examples

```
library(onewaytests)

gplot(Sepal.Length ~ Species, data = iris, type = "boxplot")
gplot(Sepal.Length ~ Species, data = iris, type = "boxplot", violin = FALSE)
gplot(Sepal.Length ~ Species, data = iris, type = "errorbar", option = "se")
gplot(Sepal.Length ~ Species, data = iris, type = "errorbar", option = "sd")
```

---

homog.test *Variance Homogeneity Tests*

Description

homog.test performs variance homogeneity tests including Levene, Bartlett, Fligner-Killeen tests.

Usage

```
homog.test(formula, data, method = c("Levene", "Bartlett", "Fligner"),
  alpha = 0.05, na.rm = TRUE, verbose = TRUE)
```

Arguments

formula	a formula of the form lhs ~ rhs where lhs gives the sample values and rhs the corresponding groups.
data	a tibble or data frame containing the variables in the formula formula
method	a character string to select one of the variance homogeneity tests. "Levene": Levene's test, "Bartlett": Bartlett's test, "Fligner": Fligner-Killeen test.
alpha	the level of significance to assess variance homogenity. Default is set to alpha = 0.05.
na.rm	a logical value indicating whether NA values should be stripped before the computation proceeds.
verbose	a logical for printing output to R console.

Value

A list containing the following components:

statistic	the corresponding test statistic.
parameter	the parameter(s) of the approximate corresponding distribution of the test statistic. The corresponding distribution is F distribution for Levene's test, Chi-square disribution for Bartlett's test and Fligner-Killeen test.
p.value	the p-value of the test.

Author(s)

Osman Dag

See Also

leveneTest bartlett.test fligner.test

Examples

```
library(onewaytests)

homog.test(Sepal.Length ~ Species, data = iris)
homog.test(Sepal.Length ~ Species, data = iris, method = "Bartlett")
```

---

james.test *James Second Order Test*

Description

james.test performs James second order test.

Usage

```
james.test(formula, data, alpha = 0.05, na.rm = TRUE, verbose = TRUE)
```

Arguments

formula	a formula of the form lhs ~ rhs where lhs gives the sample values and rhs the corresponding groups.
data	a tibble or data frame containing the variables in the formula formula
alpha	a significance level. Defaults alpha = 0.05.
na.rm	a logical value indicating whether NA values should be stripped before the computation proceeds.
verbose	a logical for printing output to R console.

Value

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

statistic	the James second order test statistic.
criticalValue	the critical value of the James second order test statistic.
alpha	the level of significance to assess the statistical difference.
method	the character string "James Second Order Test".
data	a data frame containing the variables in which NA values (if exist) are removed.
formula	a formula of the form lhs ~ rhs where lhs gives the sample values and rhs the corresponding groups.

Author(s)

Anil Dolgun

References

Cribbie, R. A., Fiksenbaum, L., Keselman, H. J., Wilcox, R. R. (2012). Effect of Non-Normality on Test Statistics for One-Way Independent Groups Designs. *British Journal of Mathematical and Statistical Psychology*, **65**, 56-73.

Dag, O., Dolgun, A., Konar, N.M. (2018). onewaytests: An R Package for One-Way Tests in Independent Groups Designs. *The R Journal*, **10:1**, 175-199.

Examples

```
library(onewaytests)

james.test(Sepal.Length ~ Species, data = iris, alpha = 0.05)

out <- james.test(Sepal.Length ~ Species, data = iris, alpha = 0.05)
paircomp(out)
```

---

johansen.test *Johansen F Test*

Description

`johansen.test` performs Johansen F test.

Usage

```
johansen.test(formula, data, alpha = 0.05, na.rm = TRUE, verbose = TRUE)
```

Arguments

`formula`	a formula of the form `lhs ~ rhs` where `lhs` gives the sample values and `rhs` the corresponding groups.
`data`	a tibble or data frame containing the variables in the formula `formula`
`alpha`	the level of significance to assess the statistical difference. Default is set to alpha = 0.05.
`na.rm`	a logical value indicating whether NA values should be stripped before the computation proceeds.
`verbose`	a logical for printing output to R console.

Value

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

`statistic`	the Johansen F test statistic.
`parameter`	the parameter(s) of the approximate F distribution of the test statistic.
`p.value`	the p-value of the test.
`alpha`	the level of significance to assess the statistical difference.
`method`	the character string "Johansen F Test".
`data`	a data frame containing the variables in which NA values (if exist) are removed.
`formula`	a formula of the form `lhs ~ rhs` where `lhs` gives the sample values and `rhs` the corresponding groups.

Author(s)

Osman Dag

References

Johansen, S. (1980). The Welch-James Approximation to the Distribution of the Residual Sum of Squares in a Weighted Linear Regression, *Biometrika*, **67:1**, 58-92.

Examples

```
library(onewaytests)

johansen.test(Sepal.Length ~ Species, data = iris)

out <- johansen.test(Sepal.Length ~ Species, data = iris)
paircomp(out)
```

---

kw.test *Kruskal-Wallis Test*

Description

`kw.test` performs Kruskal-Wallis test.

Usage

```
kw.test(formula, data, alpha = 0.05, na.rm = TRUE, verbose = TRUE)
```

Arguments

formula	a formula of the form lhs ~ rhs where lhs gives the sample values and rhs the corresponding groups.
data	a tibble or data frame containing the variables in the formula formula
alpha	the level of significance to assess the statistical difference. Default is set to alpha = 0.05.
na.rm	a logical value indicating whether NA values should be stripped before the computation proceeds.
verbose	a logical for printing output to R console.

Value

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

statistic	the Kruskal-Wallis test statistic.
parameter	the parameter(s) of the approximate chi-squared distribution of the test statistic.
p.value	the p-value of the test.
alpha	the level of significance to assess the statistical difference.
data	a data frame containing the variables in which NA values (if exist) are removed.
formula	a formula of the form lhs ~ rhs where lhs gives the sample values and rhs the corresponding groups.

Author(s)

Anil Dolgun

References

Dag, O., Dolgun, A., Konar, N.M. (2018). onewaytests: An R Package for One-Way Tests in Independent Groups Designs. *The R Journal*, **10:1**, 175-199.

Sheskin, D. J. (2004). *Handbook of Parametric and Nonparametric Statistical Procedures*. 3rd Edition. Chapman and Hall CRC. Florida: Boca Raton.

Examples

```
library(onewaytests)

kw.test(Sepal.Length ~ Species, data = iris)

out <- kw.test(Sepal.Length ~ Species, data = iris)
paircomp(out)
```

mw.test *Mann-Whitney U Test*

Description

mw.test performs Mann-Whitney U test for two samples.

Usage

```
mw.test(formula, data, alpha = 0.05, na.rm = TRUE, verbose = TRUE)
```

Arguments

formula	a formula of the form lhs ~ rhs where lhs gives the sample values and rhs the corresponding groups.
data	a tibble or data frame containing the variables in the formula formula
alpha	the level of significance to assess the statistical difference. Default is set to alpha = 0.05.
na.rm	a logical value indicating whether NA values should be stripped before the computation proceeds.
verbose	a logical for printing output to R console.

Details

Approximation to normal distribution is used to obtain the p-value.

Value

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

statistic	the Z statistic.
p.value	the p-value of the test.
alpha	the level of significance to assess the statistical difference.
data	a data frame containing the variables in which NA values (if exist) are removed.
formula	a formula of the form lhs ~ rhs where lhs gives the sample values and rhs the corresponding groups.

Author(s)

Osman Dag

See Also

wilcox.test st.test wt.test

Examples

```
library(AID)
data(AADT)

library(onewaytests)
describe(aadt ~ control, data = AADT)

mw.test(aadt ~ control, data = AADT)
```

`nor.test` *Normality Tests*

Description

`nor.test` performs normality tests including Shapiro-Wilk, Shapiro-Francia, Kolmogorov-Smirnov, Anderson-Darling, Cramer-von Mises, Pearson Chi-square tests, and also assess the normality of each group through plots.

Usage

```
nor.test(formula, data, method = c("SW", "SF", "LT", "AD", "CVM", "PT"),
  alpha = 0.05, plot = c("qqplot-histogram", "qqplot", "histogram"), mfrow = NULL,
   na.rm = TRUE, verbose = TRUE)
```

Arguments

`formula`	a formula of the form `lhs ~ rhs` where `lhs` gives the sample values and `rhs` the corresponding groups.
`data`	a tibble or data frame containing the variables in the formula `formula`
`method`	a character string to select one of the normality tests. "SW": Shapiro-Wilk test, "SF": Shapiro-Francia test, "LT": Lilliefors (Kolmogorov-Smirnov) test, "AD": Anderson-Darling test, "CVM": Cramer-von Mises test, "PT": Pearson Chi-square test.
`alpha`	the level of significance to assess normality. Default is set to alpha = 0.05.
`plot`	a character string to select one of the plots including qqplot-histogram, qqplot, histogram. The red line is the density line of normal distribution.
`mfrow`	a two element vector to draw subsequent figures.
`na.rm`	a logical value indicating whether NA values should be stripped before the computation proceeds.
`verbose`	a logical for printing output to R console.

Value

A data frame gives the test results for the normality of groups via corresponding normality.

Author(s)

Osman Dag

See Also

homog.test gplot shapiro.test

Examples

```
library(onewaytests)

nor.test(Sepal.Length ~ Species, data = iris, method = "SW", plot = "qqplot-histogram")
nor.test(Sepal.Length ~ Species, data = iris, method = "SF", plot = "qqplot", mfrow = c(1,3))
```

---

paircomp *Pairwise Comparisons*

Description

paircomp is a generic function for pairwise comparisons by adjusting p-values.

Usage

```
## S3 method for class 'owt'
paircomp(x, adjust.method = c("bonferroni", "holm", "hochberg", "hommel", "BH",
  "BY", "fdr", "none"), ...)
```

Arguments

x	a owt object.
adjust.method	Method for adjusting p values (see p.adjust). Default is set to "bonferroni".
...	Additional arguments affecting multiple comparisons of groups in one-way independent designs.

Value

Returns a data.frame of output.

Author(s)

Osman Dag

Examples

```
library(onewaytests)

out <- aov.test(Sepal.Length ~ Species, data = iris)
paircomp(out)
paircomp(out, adjust.method = "hochberg")

out2 <- kw.test(Sepal.Length ~ Species, data = iris)
paircomp(out2)
paircomp(out2, adjust.method = "hommel")

out3 <- kw.test(Sepal.Length ~ Species, data = iris)
paircomp(out3)
paircomp(out3, adjust.method = "holm")
```

---

paircomp.jt *Pairwise Comparisons for James Second Order Test*

Description

paircomp.jt performs multiple comparisons by adjusting the level of significance for James second order test.

Usage

```
## S3 method for class 'jt'
paircomp(x, adjust.method = c("bonferroni", "none"), ...)
```

Arguments

x	a jt object.
adjust.method	Method for adjusting the significance level. "bonferroni": Bonferroni correction, "none": No correction.
...	Additional arguments affecting multiple comparisons of groups in one-way independent designs.

Value

Returns a data.frame of output.

Author(s)

Osman Dag

Examples

```
library(onewaytests)

out <- james.test(Sepal.Length ~ Species, data = iris, alpha = 0.05)
paircomp(out, adjust.method = "bonferroni")
```

`ss.test` *Scott-Smith Test*

Description

`ss.test` performs Scott-Smith test.

Usage

```
ss.test(formula, data, alpha = 0.05, na.rm = TRUE, verbose = TRUE)
```

Arguments

`formula`	a formula of the form `lhs ~ rhs` where `lhs` gives the sample values and `rhs` the corresponding groups.
`data`	a tibble or data frame containing the variables in the formula `formula`
`alpha`	the level of significance to assess the statistical difference. Default is set to alpha = 0.05.
`na.rm`	a logical value indicating whether NA values should be stripped before the computation proceeds.
`verbose`	a logical for printing output to R console.

Value

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

`statistic`	the Scott-Smith test statistic.
`parameter`	the parameter(s) of the approximate chi-squared distribution of the test statistic.
`p.value`	the p-value of the test.
`alpha`	the level of significance to assess the statistical difference.
`method`	the character string "Scott-Smith Test".
`data`	a data frame containing the variables in which NA values (if exist) are removed.
`formula`	a formula of the form `lhs ~ rhs` where `lhs` gives the sample values and `rhs` the corresponding groups.

Author(s)

Osman Dag

References

Scott, A., Smith, T. (1971). Interval Estimates for Linear Combinations of Means. *Journal of the Royal Statistical Society: Series C (Applied Statistics)*, **20:3**, 276-285.

Examples

```
library(onewaytests)

ss.test(Sepal.Length ~ Species, data = iris)

out <- ss.test(Sepal.Length ~ Species, data = iris)
paircomp(out)
```

`st.test` *Student's t-Test*

Description

`st.test` performs student's t-test for two samples.

Usage

```
st.test(formula, data, alpha = 0.05, na.rm = TRUE, verbose = TRUE)
```

Arguments

`formula`	a formula of the form `lhs ~ rhs` where `lhs` gives the sample values and `rhs` the corresponding groups.
`data`	a tibble or data frame containing the variables in the formula `formula`
`alpha`	the level of significance to assess the statistical difference. Default is set to alpha = 0.05.
`na.rm`	a logical value indicating whether NA values should be stripped before the computation proceeds.
`verbose`	a logical for printing output to R console.

Value

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

`statistic`	the Student's t-test statistic.
`parameter`	the parameter(s) of the approximate t distribution of the test statistic.
`p.value`	the p-value of the test.
`alpha`	the level of significance to assess the statistical difference.

data	a data frame containing the variables in which NA values (if exist) are removed.
formula	a formula of the form lhs ~ rhs where lhs gives the sample values and rhs the corresponding groups.

Author(s)

Osman Dag

See Also

t.test wt.test

Examples

```
library(AID)
data(AADT)

library(onewaytests)
describe(aadt ~ control, data = AADT)

st.test(aadt ~ control, data = AADT)
```

---

welch.test *Welch's Heteroscedastic F Test and Welch's Heteroscedastic F Test with Trimmed Means and Winsorized Variances*

Description

welch.test performs Welch's heteroscedastic F test and Welch's heteroscedastic F test with trimmed means and Winsorized variances.

Usage

```
welch.test(formula, data, rate = 0, alpha = 0.05, na.rm = TRUE, verbose = TRUE)
```

Arguments

formula	a formula of the form lhs ~ rhs where lhs gives the sample values and rhs the corresponding groups.
data	a tibble or data frame containing the variables in the formula formula
rate	the rate of observations trimmed and winsorized from each tail of the distribution. If rate = 0, it performs Welch's heteroscedastic F test. Otherwise, Welch's heteroscedastic F test with trimmed means and Winsorized variances is performed. Default is set to rate = 0.

alpha	the level of significance to assess the statistical difference. Default is set to alpha = 0.05.
na.rm	a logical value indicating whether NA values should be stripped before the computation proceeds.
verbose	a logical for printing output to R console.

Value

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

statistic	the value of the test statistic with a name describing it.
parameter	the parameter(s) of the approximate F distribution of the test statistic.
p.value	the p-value of the test.
alpha	the level of significance to assess the statistical difference.
method	the character string "Welch's Heteroscedastic F Test" or "Welch's Heteroscedastic F Test with Trimmed Means and Winsorized Variances" depending on the choice.
rate	the rate of observations trimmed and winsorized from each tail of the distribution.
data	a data frame containing the variables in which NA values (if exist) are removed.
formula	a formula of the form `lhs ~ rhs` where `lhs` gives the sample values and `rhs` the corresponding groups.

Author(s)

Osman Dag

References

Dag, O., Dolgun, A., Konar, N.M. (2018). onewaytests: An R Package for One-Way Tests in Independent Groups Designs. *The R Journal*, **10:1**, 175-199.

Welch, B. L.(1951). On the Comparison of Several Mean Values: An Alternative Approach. *Biometrika*, **38**, 330-336.

Examples

```
library(onewaytests)

welch.test(Sepal.Length ~ Species, data = iris)
welch.test(Sepal.Length ~ Species, data = iris, rate = 0.1)


out <- welch.test(Sepal.Length ~ Species, data = iris)
paircomp(out)
```

wt.test *Welch's t-Test*

Description

wt.test performs Welch's t-test for two samples.

Usage

```
wt.test(formula, data, alpha = 0.05, na.rm = TRUE, verbose = TRUE)
```

Arguments

formula	a formula of the form lhs ~ rhs where lhs gives the sample values and rhs the corresponding groups.
data	a tibble or data frame containing the variables in the formula formula
alpha	the level of significance to assess the statistical difference. Default is set to alpha = 0.05.
na.rm	a logical value indicating whether NA values should be stripped before the computation proceeds.
verbose	a logical for printing output to R console.

Value

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

statistic	the Welch's t-test statistic.
parameter	the parameter(s) of the approximate t distribution of the test statistic.
p.value	the p-value of the test.
alpha	the level of significance to assess the statistical difference.
data	a data frame containing the variables in which NA values (if exist) are removed.
formula	a formula of the form lhs ~ rhs where lhs gives the sample values and rhs the corresponding groups.

Author(s)

Osman Dag

See Also

t.test st.test

Examples

```
library(AID)
data(AADT)

library(onewaytests)
describe(aadt ~ control, data = AADT)

wt.test(aadt ~ control, data = AADT)
```

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