Package 'onewaytests'

October 2, 2023

Type Package

Title One-Way Tests in Independent Groups Designs

Version 3.0

Date 2023-10-01

Depends R (>= 3.2.0)

Imports stats, moments, car, ggplot2, nortest, graphics, utils, wesanderson

Suggests AID, tibble

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Description Performs one-way tests in independent groups designs including homoscedastic and heteroscedastic tests. These are 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, Johansen F test, Generalized tests equivalent to Parametric Bootstrap and Fiducial tests, Alvandi's F test, Alvandi's generalized p-value, approximate F test, B square test, Cochran test, Weerahandi's generalized F test, modified Brown-Forsythe test, adjusted Welch's heteroscedastic F test, Welch-Aspin test, Permutation 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>).

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NeedsCompilation no

Repository CRAN

Date/Publication 2023-10-01 22:00:02 UTC

R topics documented:

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af.test *Alvandi's F Test*

Description

af.test performs Alvandi's F test.

Usage

```
af.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 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 Alvandi's 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 "Alvandi's 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)

Merve Kasikci

References

Sadooghi-Alvandi, S.M., Jafari, A.A., Mardani-Fard, H.A. (2012). One-Way ANOVA with Unequal Variances. *Communications in Statistics-Theory and Methods*, **41:22**, 4200-4221.

Examples

```
library(onewaytests)

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

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

---

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 `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.

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)

######
```

---

agp.test	*Alvandi's Generalized P-Value*

Description

agp.test performs Alvandi's generalized p-value.

Usage

```
agp.test(formula, data, N = 10^5, 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 formula.
N	the number of bootstrap samples. Default is set to 10^5.
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:

p.value	the Alvandi's generalized p-value.
alpha	the level of significance to assess the statistical difference.
method	the character string "Alvandi's Generalized P-Value".
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.
N	the number of bootstrap samples.

Author(s)

Merve Kasikci

References

Sadooghi-Alvandi, S.M., Jafari, A.A., Mardani-Fard, H.A. (2012). One-Way ANOVA with Unequal Variances. *Communications in Statistics-Theory and Methods*, **41:22**, 4200-4221.

Examples

```
library(onewaytests)


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

out <- agp.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 `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)
```

`ap.test`   *Approximate F Test*

Description

`ap.test` performs approximate F test.

Usage

```
ap.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 `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 approximate 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 "Approximate 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)

Merve Kasikci

References

Asiribo, O., Gurland, J. (1990). Coping with Variance Heterogeneity. *Communications in Statistics-Theory and Methods*, **19:11**, 4029-4048.

Examples

```
library(onewaytests)

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

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

---

aw.test   *Adjusted Welch's Heteroscedastic F Test*

Description

`aw.test` performs adjusted Welch's heteroscedastic F test.

Usage

```
aw.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 `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 adjusted Welch's heteroscedastic 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 "Adjusted Welch's Heteroscedastic 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

Hartung, J., Argac, D., Makambi, K.H. (2002). Small Sample Properties of Tests on Homogeneity in One-Way ANOVA and Meta-Analysis. *Statistial Papers*, **43:2**, 197-235.

Examples

```
library(onewaytests)

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

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

---

b2.test   *B Square Test*

Description

b2.test performs B square test.

Usage

```
b2.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 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 B square 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 "B Square 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)

Merve Kasikci

References

Ozdemir, A.F., Kurt, S. (2006). One Way Fixed Effect Analysis of Variance under Variance Heterogeneity and a Solution Proposal. *Selcuk Journal of Applied Mathematics*, **7:2**, 81-90.

Examples

```
library(onewaytests)

b2.test(Sepal.Length ~ Species, data = iris)

out <- b2.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 `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 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)

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

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

---

cochran.test   *Cochran Test*

Description

cochran.test performs Cochran test.

Usage

```
cochran.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 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 Cochran 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 "Cochran 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)

Merve Kasikci

References

Cochran, W.G. (1937). Problems Arising in the Analysis of a Series of Similar Experiments. Supplement to *Journal of the Royal Statistical Society*, **4:1**, 102-118.

Examples

```
library(onewaytests)

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

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

---

describe	*Descriptive Statistics*

Description

`describe` produces basic descriptive 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 `formula`.

Value

Returns a data.frame of output.

Author(s)

Osman Dag

Examples

```
library(onewaytests)

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

---

gp.test   *Test for Equal Means in a One-Way Layout under Unequal Variances*

Description

gp.test tests whether two or more samples from normal distributions have the same means when the variances are not necessarily equal.

Usage

```
gp.test(formula, data, method = c("gtb","gtf"), 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 formula.
method	a character string to select the method. "gtb": Generalized Test Equivalent to Parametric Bootstrap Test (size close to intended), "gtf": Generalized Test Equivalent to Fiducial Test (size assured).
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:

p.value	the p-value of the corresponding test.
alpha	the level of significance to assess the statistical difference.
method	the selected method used in generalized 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

The methods underlying Generalized Tests are summarized in Weerahandi and Krishnamoorthy (2019), which shows that both the Fiducial and the Parametric Bootstrap tests are generalized tests based on an exact probability statement on alternative test variables. Greater details of them can be found in Krishnamoorthy et al. (2007) and Li et al. (2011). For greater details about Generalized Inference, the reader is referred to Weerahandi (2004), which can be freely read at Generalized Inference.

For additional information about the methods and the code, the reader can contact the authors of this code, Sam Weerahandi or Malwane Ananda.

Author(s)

Sam Weerahandi, Malwane Ananda

References

Daniel, W.W., Cross, C.L. (2013). *Biostatistics: A Foundation for Analysis in the Health Sciences. (10th ed.).* John Wiley and Sons, Inc.

Krishnamoorthy, K., Lu, F., Mathew, T. (2007). A parametric bootstrap approach for ANOVA with unequal variances: fixed and random models. *Computational Statistics and Data Analysis*, **51:12**, 5731-5742.

Li, X., Wang J., Liang H. (2011). Comparison of several means: a fiducial based approach. *Computational Statistics and Data Analysis*, **55:5**, 1993-2002.

Weerahandi, S. (2004). *Generalized Inference in Repeated Measures: Exact Methods in MANOVA and Mixed Models*, Series in Probability and Statistics. John Wiley and Sons, Inc.

Weerahandi, S., Krishnamoorthy, K. (2019). A note reconciling ANOVA tests under unequal error variances. *Communications in Statistics-Theory and Methods*, **48:3**, 689-693.

Examples

```
library(onewaytests)

out <- gp.test(Sepal.Length ~ Species, data = iris, method = "gtb")
paircomp(out)

out <- gp.test(Sepal.Length ~ Species, data = iris, method = "gtf")
paircomp(out)
```

---

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

Description

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

Usage

```
gplot(formula, data, type = c("boxplot-violin", "boxplot", "violin", "errorbar"),
  width = c(0.3, 1.0, 0.2), dots = TRUE, binwidth = 0.05, color_manual = NULL,
  theme = theme_bw(), xlab = NULL, ylab = NULL, title = NULL,
  option = c("sd", "se"), bar = FALSE, 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 formula.
type	a character string to select one of the plots. "boxplot-violin": box-and-whisker plot with violin lines, "boxplot": box-and-whisker plot, "violin": violin plot, "errorbar": error bar.
width	a vector including three numeric values. First numeric represents the width of the boxes for box-and-whisker plots (defaults to 0.3). Second numeric belongs to the width of violin plot (defaults to 1.0). Third numeric represents the width of the little lines at the tops and bottoms of the error bars (defaults to 0.20).
dots	a logical to draw the dots corresponding the data values.
binwidth	a numeric to specify bin width of dot(s), defaults to 0.05.
color_manual	a vector of colors. A palette can also be defined with [wes_palette](). Default is set to "FantasticFox1" available in [wes_palette]().
theme	a theme (see [ggtheme]()). Default is set to theme_bw().
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.
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 "sd".
bar	a logical to add bar to errorbars. Default is fixed to bar = FALSE.
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)

# box-and-whisker with dots
gplot(Sepal.Length~Species, data = iris, type = "boxplot")

# box-and-whisker without dots
gplot(Sepal.Length~Species, data = iris, type = "boxplot", dots = FALSE)

# to change the width of the boxes for box-and-whisker plots
gplot(Sepal.Length~Species, data = iris, type = "boxplot", width = c(0.4, NA, NA))

# violin plot with dots
gplot(Sepal.Length~Species, data = iris, type = "violin")

# to change the width of violin plots
gplot(Sepal.Length~Species, data = iris, type = "violin", width = c(NA, 0.8, NA))

# box-and-whisker plot with violin lines and dots
gplot(Sepal.Length~Species, data = iris, type = "boxplot-violin")

# to change the width of the boxes for box-and-whisker plots and the width of violin plots
gplot(Sepal.Length~Species, data = iris, type = "boxplot-violin", width = c(0.25, 0.95, NA))

# to change the theme
library(ggplot2)
gplot(Sepal.Length~Species, data = iris, type = "boxplot-violin", width = c(0.25, 0.95, NA),
theme = theme_minimal())

# to specify the colors
gplot(Sepal.Length~Species, data = iris, type = "boxplot-violin", width = c(0.25, 0.95, NA),
color_manual=c("#999999","#E69F00","#56B4E9"))

# to specify the colors as white
gplot(Sepal.Length~Species, data = iris, type = "boxplot-violin", width = c(0.25, 0.95, NA),
color_manual=c("white","white","white"))
```

```
#to change color palette
library(wesanderson)
gplot(Sepal.Length~Species, data = iris, type = "boxplot-violin", width = c(0.25, 0.95, NA),
color_manual=wes_palette(name="GrandBudapest1",n=3))

# error bars (mean +- standard deviation) without bars
gplot(Sepal.Length~Species, data = iris, type = "errorbar", option = "sd", bar = FALSE)

# error bars (mean +- standard deviation) with bars
gplot(Sepal.Length~Species, data = iris, type = "errorbar", option = "sd", bar = TRUE)

# to change the width of the little lines at the tops and bottoms of the error bars
gplot(Sepal.Length~Species, data = iris, type = "errorbar", width = c(NA, NA, 0.25))

# error bars (mean +- standard error) without bars
gplot(Sepal.Length~Species, data = iris, type = "errorbar", option = "se", bar = FALSE)
```

---

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 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 homogeneity. 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 distribution 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 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 `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 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.
method	the character string "Kruskal-Wallis 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

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)
```

---

mbf.test   *Modified Brown-Forsythe Test*

Description

`mbf.test` performs modified Brown-Forsythe test.

Usage

```
mbf.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 `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 modified 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 "Modified 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)

Merve Kasikci

References

Mehrotra, D.V. (1997). Improving the Brown-Forsythe Solution to the Generalized Behrens-Fisher Problem. *Communications in Statistics-Simulation and Computation*, **26:3**, 1139-1145.

Examples

```
library(onewaytests)

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

out <- mbf.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 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 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))
```

---

onewaytests	*One-Way Tests for Independent Groups Designs*

Description

onewaytests is a function covering 22 one-way tests for independent groups designs.

Usage

```
onewaytests(formula, data, method = c("aov", "af", "ag", "agp", "ap", "aw", "b2",
  "bf", "box", "cochran", "gtb", "gtf", "james", "johansen", "kw", "mbf", "pf",
  "ss", "wa", "welch", "welch_tw", "wgf"), N = 10^5, rate = 0.1, 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 formula.
method	the one-way test. There are 22 tests available: one-way analysis of variance ("aov"), Welch's heteroscedastic F test ("welch"), Welch's heteroscedastic F test with trimmed means and Winsorized variances ("welch_tw"), Brown-Forsythe test ("bf"), Alexander-Govern test ("ag"), James second order test ("james"), Kruskal-Wallis test ("kw"), Scott-Smith test ("ss"), Box F test ("bf"), Generalized tests equivalent to Parametric Bootstrap ("gtb") and Fiducial ("gtf") tests, Johansen F test ("johansen"), Alvandi's F test ("af"), Alvandi's generalized p-value ("agp"), approximate F test ("af"), B square test ("b2"), Cochran test ("cochran"), Weerahandi's generalized F test ("wgf"), modified Brown-Forsythe test ("mbf"), adjusted Welch's heteroscedastic F test ("aw"), Welch-Aspin test ("wa"), Permutation F test ("pf"). Default is set to "aov".
N	the number of bootstrap samples for Weerahandi's generalized F test, Alvandi's generalized p-value, and permutation F test. Default is set to 10^5.
rate	the rate of observations trimmed and winsorized from each tail of the distribution for Welch's heteroscedastic F test with trimmed means and Winsorized variances. Default is set to rate = 0.1.
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

See the corresponding one-way test function.

Author(s)

Merve Kasikci, 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.

Examples

```
library(onewaytests)

# One-Way Analysis of Variance
onewaytests(Sepal.Length ~ Species, data = iris, method = "aov")

# Alexander-Govern test
onewaytests(Sepal.Length ~ Species, data = iris, method = "ag")

# Johansen F test
onewaytests(Sepal.Length ~ Species, data = iris, method = "johansen")

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

---

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"), verbose = TRUE, ...)
```

Arguments

x	a owt object.
adjust.method	Method for adjusting p values (see `p.adjust`). Default is set to "bonferroni".
verbose	a logical for printing output to R console.
...	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"), verbose = TRUE, ...)
```

Arguments

x	a jt object.
adjust.method	Method for adjusting the significance level. "bonferroni": Bonferroni correction, "none": No correction.
verbose	a logical for printing output to R console.
...	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")
```

---

pf.test   *Permutation F Test*

Description

`pf.test` performs Permutation F test.

Usage

```
pf.test(formula, data, N = 10^5, 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 formula.
N	the number of bootstrap samples. Default is set to 10^5.
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:

p.value	the Permutation F test p-value.
alpha	the level of significance to assess the statistical difference.
method	the character string "Permutation 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.
N	the number of bootstrap samples.

Author(s)

Osman Dag

References

Berry, K.J., Mielke Jr, P.W., Mielke, H.W. (2002). The Fisher-Pitman Permutation Test: an Attractive Alternative to the F Test. *Psychological Reports*, **90:2**, 495-502.

Examples

```
library(onewaytests)


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

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

---

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 `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 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)
```

---

wa.test	*Welch-Aspin Test*

Description

`wa.test` performs Welch-Aspin test.

Usage

```
wa.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 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-Aspin 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 "Welch-Aspin 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

Aspin, A.A. (1948). An Examination and Further Development of a Formula Arising in the Problem of Comparing Two Mean Values. *Biometrika*, **35:1/2**, 88-96.

Examples

```
library(onewaytests)

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

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

---

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 `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)
```

---

wgf.test   *Weerahandi's Generalized F Test*

Description

`wgf.test` performs Weerahandi's generalized F test.

Usage

```
wgf.test(formula, data, N = 10^5, 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 `formula`.
N	the number of bootstrap samples. Default is set to 10^5.
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:

`p.value`	the p-value of Weerahandi's generalized F test.
`alpha`	the level of significance to assess the statistical difference.
`method`	the character string "Weerahandi's Generalized 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.
`N`	the number of bootstrap samples.

Note

The user can contact the author of this code, Sam Weerahandi, for additional information about the method and the code.

Author(s)

Sam Weerahandi

References

Weerahandi, S. (1995). ANOVA under Unequal Error Variances. *Biometrics*, 589-599.

Examples

```
library(onewaytests)


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

out <- wgf.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 `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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