Package: WAnova (via r-universe)

November 17, 2024

Type Package

Title Welch's Anova from Summary Statistics

Version 0.4.0

Description Provides the functions to perform a Welch's one-way Anova
with fixed effects based on summary statistics (sample size,
means, standard deviation) and the Games-Howell post hoc test
for multiple comparisons and provides the effect size estimator
adjusted omega squared. In addition sample size estimation can
be computed based on Levy's method, and a Monte Carlo
simulation is included to bootstrap residual normality and
homoscedasticity Welch, B. L. (1951)
<doi:10.1093/biomet/38.3-4.330> Kirk, R. E. (1996)
<doi:10.1177/0013164496056005002> Carroll, R. M., & Nordholm,
L. A. (1975) <doi:10.1177/001316447503500304> Albers, C., &
Lakens, D. (2018) <doi:10.1016/j.jesp.2017.09.004> Games, P.
A., & Howell, J. F. (1976) <doi:10.2307/1164979> Levy, K. J.
(1978a) <doi:10.1080/00949657808810246> Show-Li, J., & Gwowen,
S. (2014) <doi:10.1111/bmsp.12006>.

License GPL (>= 3)

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RoxygenNote 7.3.1

Suggests rmarkdown, testthat (>= 3.0.0)

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Imports car, utils, stats, SuppDists

NeedsCompilation no

Author Niklas Burgard [aut, cre]

Maintainer Niklas Burgard <info@burgard.online>

Repository CRAN

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Config/pak/sysreqs cmake make libicu-dev

Contents

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fmax_test   *fmax.test*

Description

Performs Hartley's Fmax test for homogeneity of variances. This test assesses whether the variances of multiple groups are equal, given that the sample sizes are the same. It calculates the ratio of the maximum to the minimum variance and compares it to a critical value from the Fmax distribution to determine if there is significant deviation from homogeneity.

Usage

```
fmax_test(levels, n, sd)
```

Arguments

levels	a vector of group labels or identifiers.
n	A numeric vector of sample sizes for each group.
sd	A numeric vector of standard deviations for each group.

Value

A list with the following components:

fmax The ratio of the maximum to minimum variance.

df Degrees of freedom associated with the test.

k Number of groups.

pval The p-value of the test.

The levels parameter is used determine the number of groups. The variances are computed as the squares of sd. Note: Applicable results assume normally distributed data with equal sample sizes

Null Hypothesis: Assumes homogeneity of variances, which means all groups have the same variance. Alternative Hypothesis: Assumes that not all group variances are equal. This hypothesis is supported if the p-value is below the significance level.

Examples

```
probe_data <- data.frame(
  group = c("probe_a", "probe_b", "probe_c"),
  size = c(10, 10, 10),  # Equal sample sizes
  mean = c(43.00000, 33.44444, 35.75000),
  sd = c(4.027682, 9.302031, 16.298554)
)

# Perform Hartley's Fmax test
result <- fmax_test(
  levels = probe_data$group,
  n = probe_data$size,
  sd = probe_data$sd
)
```

---

games_howell.test   *games_howell.test*

Description

Games-Howell post hoc test for multiple comparisons after Welch's ANOVA.

Usage

```
games_howell.test(levels, n, means, sd, conf.level = 0.95)
```

Arguments

levels	A vector containing the level names of the independent variable.
n	A vector containing the sample sizes for each level.
means	A vector containing the sample means for each level.
sd	A vector containing the sample standard deviations for each level.
conf.level	The confidence level for the interval. Defaults to 0.95.

Value

A data frame of class "wAnova_gh" containing the pairwise comparisons with mean differences, standard errors, confidence intervals, t-values, degrees of freedom, and p-values. Significance codes are also included.

Examples

```
probe_data <- data.frame(
  group = c("probe_a", "probe_b", "probe_c"),
  size = c(10, 9, 8),
  mean = c(43.00000, 33.44444, 35.75000),
  sd = c(4.027682, 9.302031, 16.298554)
)
result <- games_howell.test(probe_data$group, probe_data$size, probe_data$mean, probe_data$sd)
print(result)
```

---

print.wsize   *Print Method for 'wsize' Objects*

Description

Custom print method for objects of class 'wsize'. Displays the results of the sample size determination in a user-friendly format.

Usage

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

Arguments

x	An object of class wsize.
...	Additional arguments passed to or from other methods.

Value

Prints the sample size determination results to the console.

Examples

```
# Print the results from the wsize function
n <- c(10, 10, 10, 10)
means <- c(1, 0, 0, -1)
sd <- c(1, 1, 1, 1)
result <- wanova_pwr.test(n, means, sd, power = 0.90, alpha = 0.05)
print(result)
```

---

wanova_pwr.test   *wanova_pwr.test*

Description

This function computes the approximate sample size required to achieve a desired power level for Welch's F-test in a one-way heteroscedastic ANOVA. The function takes the initial sample size, group means, and standard deviations, and iteratively determines the necessary sample size to meet the specified power and significance level.

Usage

```
wanova_pwr.test(n, means, sd, power = 0.9, alpha = 0.05)
```

Arguments

n   A numeric vector of initial sample sizes for each group.

means   A numeric vector of the means for each group.

sd   A numeric vector of the standard deviations for each group.

power   Desired power of the test. Default is 0.90.

alpha   Significance level for the test. Default is 0.05.

Details

The function adjusts the sample sizes iteratively until the desired power level is achieved. It uses the F-distribution to determine critical values and compute the power of the test. The output includes the sample size required for each group to achieve the specified power.

Reference: Levy, K. J. (1978a). Some empirical power results associated with Welch's robust analysis of variance technique. Journal of Statistical Computation and Simulation, 8, 43-48.

Value

A list containing:

n   The adjusted sample sizes for each group. If all adjusted sizes are the same, it returns a single value.

alpha   The significance level used in the computation.

power   The calculated power of the test, rounded to two decimal places.

See Also

print.wsize

Examples

```
# Example usage of the wsize function
n <- c(10, 10, 10, 10)
means <- c(1, 0, 0, -1)
sd <- c(1, 1, 1, 1)
result <- wanova_pwr.test(n, means, sd, power = 0.90, alpha = 0.05)
print(result)
```

---

welch_anova.mc   *welch_anova.mc*

Description

Monte Carlo simulation to assess residual normality and homoscedasticity across multiple groups
by generating simulated data based on provided means, standard deviations, and sample sizes.

Usage

```
welch_anova.mc(
  means,
  sd,
  n,
  n_sim = 1000,
  sim_func = NULL,
  alpha = 0.05,
  adj = TRUE
)
```

Arguments

means	Vector of means for each group.
sd	Vector of standard deviations for each group.
n	Vector of sample sizes for each group.
n_sim	Number of simulations to perform. Defaults to 1000.
sim_func	Function used for generating random samples. Defaults to rnorm().
alpha	Significance level for normality and homoscedasticity tests. Defaults to 0.05.
adj	Logical, if TRUE applies continuity correction for proportions. Defaults to TRUE.

Value

A list of class "simres" containing the proportion of simulations where residuals are normally distributed and homoscedastic.

Examples

```
means <- c(50, 55, 60)
sds <- c(10, 12, 15)
n <- c(30, 35, 40)
result <- welch_anova.mc(means = means, sd = sds, n = n, n_sim = 1000, alpha = 0.05)
print(result)
```

---

welch_anova.test   *welch_anova.test*

Description

Welch's one-way ANOVA with fixed effects (between subjects analysis) from summary statistics with unequal (unknown) variances.

Usage

```
welch_anova.test(levels, n, means, sd, effsize = "AnL")
```

Arguments

levels	Vector with level names of the independent variable
n	Vector with sample size for each level
means	Vector with sample mean for each level
sd	Vector with sample standard deviation for each level
effsize	Options "AnL" (standard), "Kirk", "CaN" (see below)

Value

A list of class "wAnova" that contains the F-value, df-between, df-within, p-value and effect size omega-squared that can later be converted to a table-styled summary using summary()

The adjusted omega squared estimator of the effect size is either calculated by the formula of of Albers and Lakens, Kirk or Caroll and Nordholm (Further notes see README file)

Albers, C., & Lakens, D. (2018). When power analyses based on pilot data are biased: Inaccurate effect size estimators and follow-up bias. Journal of Experimental Social Psychology, 74, 187–195. Kirk, R. E. (1996). Practical significance: A concept whose time has come. Educational and Psychological Measurement, 56(5), 746-759. Carroll, R. M., & Nordholm, L. A. (1975). Sampling characteristics of Kelley's epsilon and Hays' omega Educational and Psychological Measurement, 35(3), 541-554.

Examples

```
probe_data <- data.frame(
  group = c("probe_a", "probe_b", "probe_c"),
  size = c(10, 9, 8),
  mean = c(43.00000, 33.44444, 35.75000),
  sd = c(4.027682, 9.302031, 16.298554)
)
result <- welch_anova.test(
  levels = probe_data$group,
  n = probe_data$size,
  means = probe_data$mean,
  sd = probe_data$sd,
  effsize = "Kirk"
)
summary(result)
```

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