

Package ‘cocron’

July 22, 2025

Type Package

Title Statistical Comparisons of Two or more Alpha Coefficients

Author Birk Diedenhofen [aut, cre]

Maintainer Birk Diedenhofen <mail@birkdiedenhofen.de>

Depends methods

Suggests testthat

Enhances rkward

Imports stats

Description Statistical tests for the comparison between two or more alpha coefficients based on either dependent or independent groups of individuals. A web interface is available at <http://comparingcronbachalphas.org>. A plugin for the R GUI and IDE RKWard is included. Please install RKWard from <https://rkward.kde.org> to use this feature. The respective R package 'rkward' cannot be installed directly from a repository, as it is a part of RKWard.

License GPL (>= 3)

Encoding UTF-8

LazyLoad yes

URL <http://comparingcronbachalphas.org>

Version 1.0-1

Date 2016-03-11

RoxygenNote 5.0.1

NeedsCompilation no

Repository CRAN

Date/Publication 2016-03-12 00:33:28

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cocron-package	<i>The cocron Package</i>
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Description

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Details

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Statistical tests for the comparison between two or more alpha coefficients based on either dependent or independent groups of individuals. A web interface is available at <http://comparingcronbachalphas.org>. A plugin for the R GUI and IDE RKWard is included. Please install RKWard from <https://rkward.kde.org> to use this feature. The respective R package 'rkward' cannot be installed directly from a repository, as it is a part of RKWard.

Author(s)

Birk Diedenhofen

cocron

Statistical comparisons of n alpha coefficients

Description

Performs a test of significance for the difference between n alpha coefficients (Cronbach, 1951). The function expects raw data input from which the alpha coefficients are calculated.

Usage

```
cocron(data, dep = FALSE, standardized = FALSE, los = 0.05,  
       conf.level = 0.95)
```

Arguments

data	A list holding two or more data.frames/matrices with rows and columns corresponding to individuals and items, respectively. From each data.frame/matrix an alpha coefficients is determined.
dep	A logical indicating whether the alpha coefficients are based on dependent groups of individuals
standardized	A logic indicating whether a standardized Cronbach alpha should be calculated (default is FALSE).
los	A number indicating the level of significance (default is .05).
conf.level	A number defining the level of confidence for the confidence intervals of the alpha coefficients (default is .95; see cronbach.alpha.CI). The confidence intervals serve as additional information only, they are not used for the test of significance.

Details

To compare n dependent or independent alpha coefficients (Cronbach, 1951), the methods by Feldt, Woodruff, and Salih (1987) implemented in [cocron.n.coefficients](#) are used.

Value

Returns an object of the class "cocron.n.coefficients" (see [cocron.n.coefficients](#)).

References

Cronbach, L. J. (1951). Coefficient alpha and the internal structure of tests. *Psychometrika*, 16, 297-334.

Feldt, L. S., Woodruff, D. J., & Salih, F. A. (1987). Statistical inference for coefficient alpha. *Applied Psychological Measurement*, 11, 93-103.

See Also

[cocron.n.coefficients](#), [cocron.two.coefficients](#)

Examples

```
data("knowledge")

# independent alpha coefficients
cocron(knowledge, dep=FALSE)

# dependent alpha coefficients
cocron(knowledge, dep=TRUE)
```

cocron.n.coefficients *Statistical comparisons of n alpha coefficients*

Description

Performs a test of significance for the difference between n alpha coefficients (Cronbach, 1951). The function expects alpha coefficients as input.

Usage

```
cocron.n.coefficients(alpha, n, items = NULL, dep = FALSE, r = NULL,
  los = 0.05, conf.level = 0.95)
```

Arguments

<code>alpha</code>	A numeric vector containing the alpha coefficients.
<code>n</code>	A numeric vector containing the number of individuals who provided the data for the test for which alpha coefficients were determined.
<code>items</code>	A numeric vector containing the number of items the alpha coefficients are based on.
<code>dep</code>	A logical indicating whether the alpha coefficients are based on dependent groups of individuals (default is FALSE).
<code>r</code>	A matrix that contains in the upper triangle all correlations between the scores the alpha coefficients are based on (see examples). Only required if the alpha coefficients are computed for dependent groups of individuals (<code>dep = TRUE</code>).
<code>los</code>	A number indicating the level of significance (default is .05).
<code>conf.level</code>	A number defining the level of confidence for the confidence intervals of the alpha coefficients (default is .95; see cronbach.alpha.CI). The confidence intervals serve as additional information only, they are not used for the test of significance.

Details

To compare n dependent or independent alpha coefficients (Cronbach, 1951), the methods by Feldt, Woodruff, and Salih (1987) are implemented.

Value

Returns an object of the class "cocron.n.coefficients" with the following slots:

alpha	Input parameter
n	Input parameter
items	Input parameter
dep	Input parameter
r	Input parameter
los	Input parameter
conf.level	Input parameter
statistic	The value of the test statistic
distribution	The distribution of the test statistic
df	The degrees of freedom of the distribution of the test statistic
p.value	The p-value of the test
conf.int	The confidence intervals of the alpha coefficients

References

- Cronbach, L. J. (1951). Coefficient alpha and the internal structure of tests. *Psychometrika*, 16, 297-334.
- Feldt, L. S., Woodruff, D. J., & Salih, F. A. (1987). Statistical inference for coefficient alpha. *Applied Psychological Measurement*, 11, 93-103.

See Also

[cocron](#), [cocron.two.coefficients](#)

Examples

```
# independent alpha coefficients
cocron.n.coefficients(alpha=c(.784,.875,.936), items=c(5,5,5), n=c(51,101,151),
dep=FALSE)

# dependent alpha coefficients
r <- rbind(
  c(1,.8,.6,.75),
  c(NA,1,.65,.7),
  c(NA,NA,1,.55),
  c(NA,NA,NA,1)
)
cocron.n.coefficients(alpha=c(.857,.875,.800,.833), items=c(50,40,35,25), n=100,
dep=TRUE, r=r)
```

 cocron.two.coefficients

Statistical comparisons of two alpha coefficients

Description

Performs a test of significance for the difference between two alpha coefficients (Cronbach, 1951). The function expects alpha coefficients as input.

Usage

```
cocron.two.coefficients(alpha, n, dep = FALSE, r = NULL, los = 0.05,
  alternative = "two.sided")
```

Arguments

alpha	A numeric vector containing the two alpha coefficients.
n	A numeric vector containing the number of individuals who provided the data for the test for which alpha coefficients were determined.
dep	A logical indicating whether alpha coefficients are based on dependent groups of individuals (default is FALSE).
r	A single number specifying the correlation between the scores the alpha coefficients are based on. Only required if the alpha coefficients are computed for dependent groups of individuals (dep = TRUE).
los	A number indicating the level of significance (default is .05).
alternative	A character string specifying the alternative hypothesis; must be "two.sided" (default), "greater", or "less" (or just the initial letter).

Details

For comparing two dependent or independent alpha coefficients (Cronbach, 1951), the methods described in Charter and Feldt (1996) are available, which were originally introduced in Feldt (1969) and Feldt (1980).

Value

Returns an object of the class "cocron.two.coefficients" with the following slots:

alpha	Input parameter
n	Input parameter
dep	Input parameter
r	Input parameter
los	Input parameter
alternative	Input parameter

statistic	The value of the test statistic
distribution	The distribution of the test statistic
df	The degrees of freedom of the distribution of the test statistic
p.value	The p-value of the test

References

- Cronbach, L. J. (1951). Coefficient alpha and the internal structure of tests. *Psychometrika*, 16, 297-334.
- Charter, R. A., & Feldt, L. S. (1996). Testing the equality of two alpha coefficients. *Perceptual and Motor Skills*, 82, 763-768.
- Feldt, L. S. (1969). A test of the hypothesis that Cronbach's alpha or Kuder-Richardson coefficient twenty is the same for two tests. *Psychometrika*, 34, 363-373.
- Feldt, L. S. (1980). A test of the hypothesis that Cronbach's alpha reliability coefficient is the same for two tests administered to the same sample. *Psychometrika*, 45, 99-105.

See Also

[cocron](#), [cocron.n.coefficients](#)

Examples

```
# independent alpha coefficients
cocron.two.coefficients(alpha=c(.78,.71), n=c(41,151), dep=FALSE)

# dependent alpha coefficients
cocron.two.coefficients(alpha=c(.82,.89), n=27,dep=TRUE, r=.74)
```

cronbach.alpha	<i>Cronbach's Alpha</i>
----------------	-------------------------

Description

Calculates Cronbach's alpha (Cronbach, 1951), a coefficient of internal consistency. The coefficient typically serves as an estimate of the reliability of a psychometric test.

Usage

```
cronbach.alpha(x, standardized = FALSE)
```

Arguments

x	A numeric data.frame/matrix with rows and columns corresponding to individuals and items, respectively.
standardized	A logic indicating whether a standardized Cronbach alpha should be calculated (default is FALSE).

Details

For a test consisting of k items that measures a quantity X , Cronbach's alpha is defined as

$$\alpha = \frac{k}{k-1} \left(1 - \frac{\sum_{i=1}^k \sigma_{Y_i}^2}{\sigma_X^2} \right)$$

with $X = Y_1 + Y_2 + \dots + Y_k$. $\sigma_{Y_i}^2$ is the variance of item i , and σ_X^2 the variance of the total test score for a sample of individuals that completed the test.

The standardized Cronbach's alpha is defined as

$$\alpha_s = \frac{k\bar{r}}{(1 + (k-1)\bar{r})}$$

where k is the number of items and $\bar{r}$ the mean correlation between the items.

Cases that have missing values on any of the items are excluded.

Value

Returns Cronbach's alpha as a numeric object.

References

Cronbach, L. J. (1951). Coefficient alpha and the internal structure of tests. *Psychometrika*, 16, 297-334.

See Also

[cocron](#), [cocron.n.coefficients](#), [cocron.two.coefficients](#)

Examples

```
data("knowledge")

cronbach.alpha(knowledge$test1)
cronbach.alpha(knowledge$test2)
```

cronbach.alpha.CI	<i>Confidence interval for Cronbach's Alpha</i>
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Description

Calculates a confidence interval for Cronbach's alpha (Cronbach, 1951).

Usage

```
cronbach.alpha.CI(alpha, n, items, conf.level = 0.95)
```


Arguments

<code>alpha</code>	A numeric specifying the alpha coefficient.
<code>n</code>	A numeric defining the number of individuals who provided the data for the test for which the alpha coefficient was determined.
<code>items</code>	A numeric specifying the number of items the alpha coefficient is based on.
<code>conf.level</code>	A number defining the level of confidence for the confidence interval (default is .95).

Details

The lower bound of a confidence interval for an α that is based on the data of n individuals who responded to k items is defined as

$$L = 1 - ((1 - \alpha)F(1 - c/2))$$

where c is the level of confidence and $F(1 - c/2)$ the 100(1 - $c/2$) percentile of the F-distribution with $df_1 = n - 1$ and $df_2 = (n - 1)(k - 1)$ (Feldt, Woodruff, & Salih, 1987, p. 95, formula 6). The upper bound of the confidence interval is computed as

$$U = 1 - ((1 - \alpha)F(c/2))$$

(Feldt et al., 1987, p. 95, formula 7).

Value

Returns a confidence interval for Cronbach's alpha as a numeric vector.

References

- Cronbach, L. J. (1951). Coefficient alpha and the internal structure of tests. *Psychometrika*, 16, 297-334.
- Feldt, L. S., Woodruff, D. J., & Salih, F. A. (1987). Statistical inference for coefficient alpha. *Applied Psychological Measurement*, 11, 93-103.

See Also

[cronbach.alpha](#)

Examples

```
cronbach.alpha.CI(alpha=.83, n=100, items=20, conf.level=.95)
```

`knowledge`*Sample dataset: knowledge*

Description

Data of 312 testees who completed two tests on general knowledge consisting of 30 questions each.

Usage

```
data(knowledge)
```

Format

A list that contains a matrix for each of the two tests holding 312 observations (rows) on the 30 questions (columns) presented. The ones and zeros stand for correct and incorrect responses, respectively.

Examples

```
data(knowledge)
```

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