Package ‘diffcor’

January 21, 2024

Type Package

Title Fisher's z-Tests Concerning Difference of Correlations

Version 0.8.2

Depends R (>= 4.3.0), MASS

Date 2024-01-20

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Description
Computations of Fisher's z-tests concerning different kinds of correlation differences. Additionally, approaches to estimating statistical power via Monte Carlo simulations are implemented.

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Encoding UTF-8

NeedsCompilation no

Repository CRAN

Date/Publication 2024-01-21 11:22:54 UTC

R topics documented:

diffcor.dep — *Fisher's z-Tests of dependent correlations*

Description

Tests if the correlation between two variables (r12) differs from the correlation between the first and a third one (r13), given the intercorrelation of the compared constructs (r23). All correlations are automatically transformed with the Fisher z-transformation prior to computations. The output provides the compared correlations, test statistic as z-score, and p-values.

Usage

```
diffcor.dep(r12, r13, r23, n, cor.names = NULL,
alternative = c("one.sided", "two.sided"), digit = 3)
```

Arguments

`r12`	Correlation between the criterion with which both competing variables are correlated and the first of the two competing variables.
`r13`	Correlation between the criterion with which both competing variables are correlated and the second of the two competing variables.
`r23`	Intercorrelation between the two competing variables.
`n`	Sample size in which the observed effect was found
`cor.names`	OPTIONAL, label for the correlation. DEFAULT is NULL
`alternative`	A character string specifying if you wish to test one-sided or two-sided differences
`digit`	Number of digits in the output for all parameters, DEFAULT = 3

Value

`r12`	Correlation between the criterion with which both competing variables are correlated and the first of the two competing variables.
`r13`	Correlation between the criterion with which both competing variables are correlated and the second of the two competing variables.
`r23`	Intercorrelation between the two competing variables.
`z`	Test statistic for correlation difference in units of z distribution
`p`	p value for one- or two-sided testing, depending on alternative = c("one.sided", "two.sided)

Author(s)

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References

Cohen, J. (1988). Statistical power analysis for the behavioral sciences (2nd ed.). Lawrence Erlbaum.

Eid, M., Gollwitzer, M., & Schmitt, M. (2015). Statistik und Forschungsmethoden (4.Auflage) [Statistics and research methods (4th ed.)]. Beltz.

Steiger, J. H. (1980). Tests for comparing elements of a correlation matrix. Psychological Bulletin, 87, 245-251.

Examples

```
diffcor.dep(r12 = .76, r13 = .70, r23 = .50, n = 271, digit = 4,
cor.names = NULL, alternative = "two.sided")
```

`diffcor.one` *Fisher's z-test of difference between an empirical and a hypothesized correlation*

Description

The function tests whether an observed correlation differs from an expected one, for example, in construct validation. All correlations are automatically transformed with the Fisher z-transformation prior to computations. The output provides the compared correlations, a z-score, a p-value, a confidence interval, and the effect size Cohens q. According to Cohen (1988), q = |.10|, |.30| and |.50| are considered small, moderate, and large differences, respectively.

Usage

```
diffcor.one(emp.r, hypo.r, n, alpha = .05, cor.names = NULL,
alternative = c("one.sided", "two.sided"), digit = 3)
```

Arguments

`emp.r`	Empirically observed correlation
`hypo.r`	Hypothesized correlation which shall be tested
`n`	Sample size in which the observed effect was found
`alpha`	Likelihood of Type I error, DEFAULT = .05
`cor.names`	OPTIONAL, label for the correlation (e.g., "IQ-performance"). DEFAULT is NULL
`digit`	Number of digits in the output for all parameters, DEFAULT = 3
`alternative`	A character string specifying if you wish to test one-sided or two-sided differences

Value

- `r_exp` Vector of the expected correlations
- `r_obs` Vector of the empirically observed correlations
- `LL` Lower limit of the confidence interval of the empirical correlation, given the specified alpha level, DEFAULT = 95 percent
- `UL` Upper limit of the confidence interval of the empirical correlation, given the specified alpha level, DEFAULT = 95 percent
- `z` Test statistic for correlation difference in units of z distribution
- `p` p value for one- or two-sided testing, depending on alternative = c("one.sided", "two.sided)
- `Cohen_q` Effect size measure for differences of independent correlations

Author(s)

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References

Cohen, J. (1988). Statistical power analysis for the behavioral sciences (2nd ed.). Lawrence Erlbaum.

Eid, M., Gollwitzer, M., & Schmitt, M. (2015). Statistik und Forschungsmethoden (4.Auflage) [Statistics and research methods (4th ed.)]. Beltz.

Steiger, J. H. (1980). Tests for comparing elements of a correlation matrix. Psychological Bulletin, 87, 245-251.

Examples

```
diffcor.one(c(.76, .53, -.32), c(.70, .35, -.40),
  c(225, 250, 210),
  cor.names = c("a-b", "c-d", "e-f"), digit = 2, alternative = "one.sided")
```

`diffcor.two` *Fisher's z-Tests for differences of correlations in two independent samples*

Description

Tests whether the correlation between two variables differs across two independent studies/samples. The correlations are automatically transformed with the Fisher z-transformation prior to computations. The output provides the compared correlations, test statistic as z-score, p-values, confidence intervals of the empirical correlations, and the effect size Cohens q. According to Cohen (1988), q = |.10|, |.30| and |.50| are considered small, moderate, and large differences, respectively.

Usage

```
diffcor.two(r1, r2, n1, n2, alpha = .05, cor.names = NULL,
alternative = c("one.sided", "two.sided"), digit = 3)
```

Arguments

`r1`	Correlation coefficient in first sample
`r2`	Correlation coefficient in second sample
`n1`	First sample size
`n2`	Second sample size
`alpha`	Likelihood of Type I error, DEFAULT = .05
`cor.names`	OPTIONAL, label for the correlation (e.g., "IQ-performance"). DEFAULT is NULL
`digit`	Number of digits in the output for all parameters, DEFAULT = 3
`alternative`	A character string specifying if you wish to test one-sided or two-sided differences

Value

`r1`	Vector of the empirically observed correlations in the first sample
`r2`	Vector of the empirically observed correlations in the second sample
`LL1`	Lower limit of the confidence interval of the first empirical correlation, given the specified alpha level, DEFAULT = 95 percent
`UL1`	Upper limit of the confidence interval of the first empirical correlation, given the specified alpha level, DEFAULT = 95 percent
`LL2`	Lower limit of the confidence interval of the second empirical correlation, given the specified alpha level, DEFAULT = 95 percent
`UL2`	Upper limit of the confidence interval of the second empirical correlation, given the specified alpha level, DEFAULT = 95 percent
`z`	Test statistic for correlation difference in units of z distribution
`p`	p value for one- or two-sided testing, depending on alternative = c("one.sided", "two.sided)
`Cohen_q`	Effect size measure for differences of independent correlations

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References

Cohen, J. (1988). Statistical power analysis for the behavioral sciences (2nd ed.). Lawrence Erlbaum.

Eid, M., Gollwitzer, M., & Schmitt, M. (2015). Statistik und Forschungsmethoden (4.Auflage) [Statistics and research methods (4th ed.)]. Beltz.

Steiger, J. H. (1980). Tests for comparing elements of a correlation matrix. Psychological Bulletin, 87, 245-251.

Examples

```
diffcor.two(r1 = c(.39, .52, .22),
  r2 = c(.29, .44, .12),
  n1 = c(66, 66, 66), n2 = c(96, 96, 96), alpha = .01,
  cor.names = c("a-b", "c-d", "e-f"), alternative = "one.sided")
```

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diffpwr.dep — *Monte Carlo Simulation for the correlation difference between dependent correlations*

Description

Computation of a Monte Carlo simulation to estimate the statistical power of the comparison between the correlations of a variable with two competing variables that are also correlated with each other.

Usage

```
diffpwr.dep(n, r12, r13, r23, alpha = 0.05, n.samples = 1000, seed = 1234)
```

Arguments

`n`	Sample size to be tested in the Monte Carlo simulation.
`r12`	Correlation between the criterion with which both competing variables are correlated and the first of the two competing variables.
`r13`	Correlation between the criterion with which both competing variables are correlated and the second of the two competing variables.
`r23`	Intercorrelation between the two competing variables.
`alpha`	Type I error. Default is .05.
`n.samples`	Number of samples generated in the Monte Carlo simulation. The recommended minimum is 1000 iterations, which is also the default.
`seed`	To make the results reproducible, it is recommended to set a random seed.

Details

Depending on the number of generated samples (‘n.samples‘), correlation coefficients of the sizes ‘r12‘, ‘r13‘, and ‘r23‘ are simulated. For each simulated sample, it is checked whether the correlations r12 and r13 differ, given the correlation ‘r23‘. The ratio of simulated z-tests of the correlation difference tests exceeding the critical z-value, given the intended alpha-level, equals the achieved statistical power (‘n‘; see Muthén & Muthén, 2002 <doi:10.1207/S15328007SEM0904_8>; Robert & Casella, 2010 <doi:10.1007/978-1-4419-1576-4>, for overviews of the Monte Carlo method).

Value

`r12`	Correlation between the criterion with which both competing variables are correlated and the first of the two competing variables.
`cov12`	Coverage. Indicates the ratio of simulated confidence intervals including the assumed effect size r12.
`bias12`	Average relative deviation of the simulated correlations r12 from the intended one.
`r13`	Correlation between the criterion with which both competing variables are correlated and the second of the two competing variables.
`cov13`	Coverage. Indicates the ratio of simulated confidence intervals including the assumed effect size r13.
`bias13`	Average relative deviation of the simulated correlations r13 from the intended one.
`r23`	Intercorrelation between the two competing variables.
`cov23`	Coverage. Indicates the ratio of simulated confidence intervals including the assumed effect size r23.
`bias23`	Average relative deviation of the simulated correlations r23 from the intended one.
`n`	Sample size to be tested in the Monte Carlo simulation.
`pwr`	Statistical power as the ratio of simulated difference tests that yielded significance.

Biases should be as close to zero as possible and coverage should be ideally between .91 and .98 (Muthén & Muthén, 2002 <doi:10.1207/S15328007SEM0904_8>).

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References

Muthén, L. K., & Muthén, B. O. (2002). How to use a Monte Carlo study to decide on sample size and determine power. Structural Equation Modeling: A Multidisciplinary Journal, 9(4), 599–620. https://doi.org/10.1207/S15328007SEM0904_8

Robert, C., & Casella, G. (2010). Introducing Monte Carlo methods with R. Springer. https://doi.org/10.1007/978-1-4419-1576-4

Examples

```
diffpwr.dep(n.samples = 1000, n = 250, r12 = .30, r13 = .45,
                     r23 = .50, alpha = .05, seed = 1234)
```

diffpwr.one — *Monte Carlo Simulation for the correlation difference between an expected and an observed correlation*

Description

Computation of a Monte Carlo simulation to estimate the statistical power the correlation difference between an observed correlation coefficient and an a fixed value against which the correlation should be tested.

Usage

```
diffpwr.one(n, emp.r, hypo.r, alpha = .05, n.samples = 1000, seed = 1234)
```

Arguments

`n`	Sample size to be tested in the Monte Carlo simulation.
`emp.r`	Assumed observed correlation.
`hypo.r`	Correlation coefficient against which to test.
`alpha`	Type I error. Default is .05.
`n.samples`	Number of samples generated in the Monte Carlo simulation. The recommended minimum is 1000 iterations, which is also the default.
`seed`	To make the results reproducible, it is recommended to set a random seed.

Details

Depending on the number of generated samples (‘n.samples‘), correlation coefficients of the size ‘emp.r‘ are simulated. Confidence intervals are built around the simulated correlation coefficients. For each simulated coefficient, it is then checked whether the hypothesized correlation cofficient (‘hypo.r‘) falls within this interval. All correlations are automatically transformed with the Fisher z-transformation prior to computations. The ratio of simulated confidence intervals excluding the hypothesized coefficient equals the statistical power, given the actual sample size (‘n‘; see Robert & Casella, 2010 <doi:10.1007/978-1-4419-1576-4>, for an overview of the Monte Carlo method).

Value

`emp.r`	Empirically observed correlation.
`hypo.r`	Correlation against which ‘emp.r‘ should be tested.
`n`	The sample size entered in the function.
`cov`	Coverage. Indicates the ratio of simulated confidence intervals including the assumed correlation ‘emp.r‘. Should be between .91 and .98 (Muthén & Muthén, 2002 <doi:10.1207/S15328007SEM0904_8>).
`bias`	Average relative difference between the assumed ‘emp.r‘ and the simulated correlations.
`pwr`	Statistical power as the ratio of simulated confidence intervals excluding the hypothesized correlation.

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References

Muthén, L. K., & Muthén, B. O. (2002). How to use a Monte Carlo study to decide on sample size and determine power. Structural Equation Modeling: A Multidisciplinary Journal, 9(4), 599–620. https://doi.org/10.1207/S15328007SEM0904_8

Robert, C., & Casella, G. (2010). Introducing Monte Carlo methods with R. Springer. https://doi.org/10.1007/978-1-4419-1576-4

Examples

```
diffpwr.one(n.samples = 1000, n = 500, emp.r = .30, hypo.r = .40, alpha = .05,
            seed = 1234)
```

`diffpwr.two` *Monte Carlo Simulation for the correlation difference between two correlations that were observed in two independent samples*

Description

Computation of a Monte Carlo simulation to estimate the statistical power the correlation difference between the correlation coefficients detected in two indepdenent samples (e.g., original study and replication study).

Usage

```
diffpwr.two(n1, n2, r1, r2, alpha = .05, n.samples = 1000, seed = 1234)
```

Arguments

`n1`	Sample size to be tested in the Monte Carlo simulation for the first sample.
`n2`	Sample size to be tested in the Monte Carlo simulation for the second sample.
`r1`	Correlarion observed in the first sample.
`r2`	Correlarion observed in the second sample.
`alpha`	Type I error. Default is .05.
`n.samples`	Number of samples generated in the Monte Carlo simulation. The recommended minimum is 1000 iterations, which is also the default.
`seed`	To make the results reproducible, a random seed is specified.

Details

Depending on the number of generated samples (‘n.samples‘), correlation coefficients of the sizes ‘r1‘ and ‘r2‘ are simulated. For each simulated pair of coefficients, it is then checked whether the confidence intervals (with given alpha level) of the correlations overlap. All correlations are automatically transformed with the Fisher z-transformation prior to computations. The ratio of simulated non-overlapping confidence intervals equals the statistical power, given the actual sample sizes (‘n1‘ and ‘n2‘; see Robert & Casella, 2010 <doi:10.1007/978-1-4419-1576-4>, for an overview of the Monte Carlo method).

Value

`r1`	Correlation observed in sample 1.
`n1`	The sample size of the first sample.
`cov1`	Coverage. Ratio of simulated confidence intervals including r1.
`bias1`	Average relative difference between r1 and simulated correlations.
`r2`	Correlation observed in sample 2.
`n2`	The sample size of the second sample.
`cov2`	Coverage. Ratio of simulated confidence intervals including r2.
`bias2`	Average relative difference between r2 and simulated correlations.
`pwr`	Statistical power as the ratio of simulated non-verlapping confidence intervals.

Biases should be as close to zero as possible and coverage should be ideally between .91 and .98 (Muthén & Muthén, 2002 <doi:10.1207/S15328007SEM0904_8>).

Author(s)

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References

Muthén, L. K., & Muthén, B. O. (2002). How to use a Monte Carlo study to decide on sample size and determine power. Structural Equation Modeling: A Multidisciplinary Journal, 9(4), 599–620. https://doi.org/10.1207/S15328007SEM0904_8

Robert, C., & Casella, G. (2010). Introducing Monte Carlo methods with R. Springer. https://doi.org/10.1007/978-1-4419-1576-4

Examples

```
diffpwr.two(n.samples = 1000, n1 = 1000, n2 = 594, r1 = .45, r2 = .39,
           alpha = .05, seed = 1234)
```

visual_mc — *Visualization of the simulated parameters*

Description

To evaluate the quality of the Monte Carlo simulation beyond bias and coverage parameters (Muthén & Muthén, 2002), it can be helpful to also inspect the simulated parameters visually. To this end, visual_mc() can be used to visualize the simulated parameters (including corresponding confidence intervals) in relation to the targeted parameter.

Usage

```
visual_mc(emp.r, n, alpha = .05, n.intervals = 100, seed = 1234)
```

Arguments

`emp.r`	Targeted correlation coefficient of the simulation.
`n`	An integer reflecting the sample size.
`alpha`	Type I error. Default is .05.
`n.intervals`	An integer reflecting the number of simulated parameters that should be visualized in the graphic. Default is 100.
`seed`	To make the results reproducible, a random seed is specified.

Value

A plot in which the targeted correlation coefficient is visualized with a dashed red line and the simulated correlation coefficients are visualized by black squares and confidence intervals (level depending on the specification made in the argument 'alpha').

Author(s)

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References

Muthén, L. K., & Muthén, B. O. (2002). How to use a Monte Carlo study to decide on sample size and determine power. Structural Equation Modeling: A Multidisciplinary Journal, 9(4), 599–620. https://doi.org/10.1207/S15328007SEM0904_8

Examples

```
visual_mc(emp.r = .25,
                    n = 300,
                    alpha = .05,
                    n.intervals = 100,
                    seed = 1234)
```

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