Package ‘semTests’

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Type Package

Title Goodness-of-Fit Testing for Structural Equation Models

Description Supports eigenvalue block-averaging p-values (Foldnes, Grønneberg, 2018) <doi:10.1080/10705511.2017.1373021>, penalized eigenvalue block-averaging p-values (Foldnes, Moss, Grønneberg, 2024) <doi:10.1080/10705511.2024.2372028>, penalized regression p-values (Foldnes, Moss, Grønneberg, 2024) <doi:10.1080/10705511.2024.2372028>, as well as traditional p-values such as Satorra-Bentler. All p-values can be calculated using unbiased or biased gamma estimates (Du, Bentler, 2022) <doi:10.1080/10705511.2022.2063870> and two choices of chi square statistics.

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License GPL (>= 3)

Encoding UTF-8

URL `https://github.com/JonasMoss/semTests`

Depends R (>= 3.5.0)

Imports lavaan (>= 0.6-16), CompQuadForm, RSpectra, MASS, Matrix, methods

Suggests covr, testthat (>= 3.0.0), psych

Config/testthat/edition 3

RoxygenNote 7.3.3

NeedsCompilation no

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Contents

`pvalues` *Calculate* p-*values for one or two* `lavaan` *objects.*

Description

Calculate *p*-values for a `lavaan` object using several methods, including penalized eigenvalue block-averaging and penalized regression estimators. The recommended choices of *p*-values are included as default values. Multiple *p*-values can be returned simultaneously.

Usage

```
pvalues(object, tests = c("pEBA4_RLS"))

pvalues_nested(m0, m1, method = c("2000", "2001"), tests = c("PALL_UG_ML"))
```

Arguments

`object, m0, m1`	One or two `lavaan` objects. `pvalues` does goodness-of-fit testing on one object, `pvalues_nested` does hypothesis testing on two nested models.
`tests`	A list of tests to evaluate on the form `"(test)_(ug?)_(rls?)"`; see the default arguments and details below. The defaults are the recommended options.
`method`	For nested models, choose between `2000` and `2001`. Note: `2001` and Satorra-Bentler will not correspond with the variant in the paper.

Details

The test argument is a list of character strings on the form (test)*(ug?)*(ml?), for instance, `SB_UG_RLS`.

- The first part of the string specifies the desired test. The supported tests are listed below.
- If `UG` is included in the string the unbiased estimator of the fourth order moment matrix (Du, Bentler, 2022) is used. If not, the standard biased matrix is used. There is no simple relationship between *p*-value performance and the choice of `unbiased`.
- The final part of specifies the chi square statistic. The `ML` choice uses the chi square based on the normal discrepancy function (Bollen, 2014). The `RLS` choice (default) uses the reweighted least squares statistic of Browne (1974).

The `eba` method partitions the eigenvalues into `j` equally sized sets (if not possible, the smallest set is incomplete), and takes the mean eigenvalue of these sets. Provide a list of integers `j` to partition with respect to. The method was proposed by Foldnes & Grønneberg (2018). `eba` with `j=2` – `j=4` appear to work best.

The peba method is a penalized variant of eba, described in (Foldnes, Moss, Grønneberg, 2024). It typically outperforms eba, and the best choice of j are typically about 2–6.

pols is a penalized regression method with a penalization term from ranging from 0 to infinity. Foldnes, Moss, Grønneberg (2024) studied pols=2, which has good performance in a variety of contexts.

pall uses all eigenvalues in ugamma, but penalizes them. This is the recommended option for nested models. all uses all eigenvalues.

In addition, you may specify a

- std the standard *p*-value where the choice of chisq is approximated by a chi square distribution.
- sb Satorra-Bentler *p*-value. The *p*-value proposed by Satorra and Bentler (1994).
- ss The scaled and shifted *p*-value proposed by Asparouhov & Muthén (2010).
- sf The scaled *F* *p*-value proposed by Wu and Lin (2016).

The unbiased argument is TRUE if the the unbiased estimator of the fourth order moment matrix (Du, Bentler, 2022) is used. If FALSE, the standard biased matrix is used. There is no simple relationship between p-value performance and the choice of unbiased.

The chisq argument controls which basic test statistic is used. The ml choice uses the chi square based on the normal discrepancy function (Bollen, 2014). The rls choice uses the reweighted least squares statistic of Browne (1974).

Value

A named vector of p-values.

References

Foldnes, N., Moss, J., & Grønneberg, S. (2024). Improved goodness of fit procedures for structural equation models. Structural Equation Modeling: A Multidisciplinary Journal, 1-13. https://doi.org/10.1080/10705511.2024.2

Satorra, A., & Bentler, P. M. (1994). Corrections to test statistics and standard errors in covariance structure analysis. https://psycnet.apa.org/record/1996-97111-016

Asparouhov, & Muthén. (2010). Simple second order chi-square correction. Mplus Technical Appendix. https://www.statmodel.com/download/WLSMV_new_chi21.pdf

Wu, H., & Lin, J. (2016). A Scaled F Distribution as an Approximation to the Distribution of Test Statistics in Covariance Structure Analysis. Structural Equation Modeling. https://doi.org/10.1080/10705511.2015.1057733

Foldnes, N., & Grønneberg, S. (2018). Approximating Test Statistics Using Eigenvalue Block Averaging. Structural Equation Modeling, 25(1), 101-114. https://doi.org/10.1080/10705511.2017.1373021

Du, H., & Bentler, P. M. (2022). 40-Year Old Unbiased Distribution Free Estimator Reliably Improves SEM Statistics for Nonnormal Data. Structural Equation Modeling: A Multidisciplinary Journal, 29(6), 872-887. https://doi.org/10.1080/10705511.2022.2063870

Bollen, K. A. (2014). Structural Equations with Latent Variables (Vol. 210). John Wiley & Sons. https://doi.org/10.1002/9781118619179

Browne. (1974). Generalized least squares estimators in the analysis of covariance structures. South African Statistical Journal. https://doi.org/10.10520/aja0038271x_175

Examples

```
library("semTests")
library("lavaan")
model <- "A =~ A1+A2+A3+A4+A5;
          C =~ C1+C2+C3+C4+C5"
n <- 200
object <- sem(model, psych::bfi[1:n, 1:10], estimator = "MLM")
pvalues(object)

# For the pEBA6 method with biased gamma and ML chisq statistic:
pvalues(object, "pEBA6_ML")
```

`sparsify` *Create sparse matrix*

Description

Create sparse matrix

Usage

```
sparsify(mat, lim = 1e-09)
```

Arguments

`mat`	Matrix input.
`lim`	Elements with absolute value less than `lim` get set to `0`.

Value

Object of `dgCMatrix`.

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