Package 'phantSEM'

May 9, 2026

Title Create Phantom Variables in Structural Equation Models for Sensitivity Analyses

Version 1.0.1

Description Create phantom variables, which are variables that were not observed, for the purpose of sensitivity analyses for structural equation models. The package makes it easier for a user to test different combinations of covariances between the phantom variable(s) and observed variables. The package may be used to assess a model's or effect's sensitivity to temporal bias (e.g., if cross-sectional data were collected) or confounding bias.

Encoding UTF-8

RoxygenNote 7.3.2

Imports tidyr(>= 1.3.0), dplyr(>= 1.1.0), corpcor(>= 1.6.10), lavaan(>= 0.6-11)

Suggests knitr, rmarkdown, testthat (>= 3.0.0), devtools, tidyverse

VignetteBuilder knitr

Depends R (>= 3.5.1)

Config/testthat/edition 3

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NeedsCompilation no

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Repository CRAN

Date/Publication 2026-01-13 15:40:02 UTC

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ghost_par_ests *Provide parameter estimates from sensitivity analysis function*

Description

ghost_par_ests() Selects certain parameter estimates from the output of the sensitivity analysis.

Usage

```
ghost_par_ests(step3, parameter_label, remove_NA = FALSE)
```

Arguments

step3	The object returned from SA_step3.
parameter_label	The label used for the parameter in the lavaan code.
remove_NA	Remove rows for combinations of phantom variable parameters that resulted in inadmissible solutions in lavaan.

Value

A dataframe of the parameter estimates from the lavaan model.

Examples

```
# example code

covmatrix <- matrix(c(
  0.25, 0.95, 0.43,
  0.95, 8.87, 2.66,
  0.43, 2.66, 10.86
), nrow = 3, byrow = TRUE)
colnames(covmatrix) <- c("X", "M2", "Y2")

# lavann syntax for observed model
observed <- " M2 ~ X
              Y2 ~ M2+X "

# lavaan output
obs_output <- lavaan::sem(model = observed, sample.cov = covmatrix, sample.nobs = 200)

# lavaan syntax for phantom variable model
phantom <- " M2 ~ M1 + Y1 + a*X
               Y2 ~ M1 + Y1 + b*M2 + cp*X "

Step1 <- SA_step1(
  lavoutput = obs_output,
  mod_obs = observed,
```

```
  mod_phant = phantom
)

phantom_assignment <- list(
  "CovM1X" = 0,
  "CovY1M1" = "CovY2M2",
  "CovY1X" = 0,
  "VarM1" = 1,
  "VarY1" = 1,
  "CovM1M2" = seq(.4, .6, .1),
  "CovY1Y2" = "CovM1M2",
  "CovY1M2" = seq(.2, .4, .1),
  "CovM1Y2" = "CovY1M2"
)
Step2 <- SA_step2(
  phantom_assignment = phantom_assignment,
  step1 = Step1
)
Step3 <- SA_step3(
  step2 = Step2,
  n = 200
)

b_results <- ghost_par_ests(
  step3 = Step3,
  parameter_label = "b",
  remove_NA = TRUE
)
```

`SA_lookup` *Lookup Table for Sensitivity Analysis*

Description

`SA_lookup()` is used to look up the sensitivity analysis results for a two-wave mediation model when provided with the cross-sectional correlations.

Usage

```
SA_lookup(CorXM, CorXY, CorMY)
```

Arguments

`CorXM`	The observed correlation between predictor X and mediator M.
`CorXY`	The observed correlation between predictor X and outcome Y.
`CorMY`	The observed correlation between mediator M and outcome Y.

Value

Results of a sensitivity analysis with varying cross-lagged and autoregressive correlations.

Examples

```
# specify correlations
xm <- .2
xy <- .3
my <- .4

output <- SA_lookup(
  CorXM = xm,
  CorXY = xy,
  CorMY = my
)
```

SA_step1 *Sensitivity Analysis Function Step 1*

Description

SA_step1() is used to identify the phantom variables and generate names for their covariance parameters. The output of this function will be used in SA_step2().

Usage

```
SA_step1(lavoutput, mod_obs, mod_phant)
```

Arguments

lavoutput	The lavaan output object output from lavaan functions sem() or lavaan() when fitting your observed model.
mod_obs	A lavaan syntax for the observed model.
mod_phant	A lavaan syntax for the phantom variable model.

Value

a list containing the names of all phantom covariance parameters.

Examples

```
# covariance matrix
covmatrix <- matrix(c(
  0.25, 0.95, 0.43,
  0.95, 8.87, 2.66,
  0.43, 2.66, 10.86
), nrow = 3, byrow = TRUE)
colnames(covmatrix) <- c("X", "M2", "Y2")

# lavann syntax for observed model
observed <- " M2 ~ X
              Y2 ~ M2+X "
```

```
# lavaan output
obs_output <- lavaan::sem(model = observed, sample.cov = covmatrix, sample.nobs = 200)

# lavaan syntax for phantom variable model
phantom <- " M2 ~ M1 + Y1 + a*X
             Y2 ~ M1 + Y1 + b*M2 + cp*X "

Step1 <- SA_step1(
  lavoutput = obs_output,
  mod_obs = observed,
  mod_phant = phantom
)
```

SA_step2 *Step 2 of sensitivity analysis function*

Description

SA_step2() is used to assign values to the phantom covariances. There are three options for assigning values to the phantom covariances: 1. Fix phantom covariance to a numeric value (i.e., 0 or 1), 2. Fix phantom covariance to be equal to another covariance, or 3. Test different values for the phantom covariance.

Usage

```
SA_step2(phantom_assignment, step1)
```

Arguments

phantom_assignment	A list of all phantom parameter names (copied from SA_step1() output) which assigns them to be equal to ONE of the following: 1) an observed parameter name, 2) a single numeric value, 3) a sequence of values, or 4) another phantom variable that has been set equal to 1-3.
step1	The output object created in SA_step1()

Value

A list containing test covariance matrices that the phantom model will be fit to.

Examples

```
covmatrix <- matrix(c(
  0.25, 0.95, 0.43,
  0.95, 8.87, 2.66,
  0.43, 2.66, 10.86
), nrow = 3, byrow = TRUE)
```

```
colnames(covmatrix) <- c("X", "M2", "Y2")

# lavann syntax for observed model
observed <- " M2 ~ X
             Y2 ~ M2+X "

# lavaan output
obs_output <- lavaan::sem(model = observed, sample.cov = covmatrix, sample.nobs = 200)

# lavaan syntax for phantom variable model
phantom <- " M2 ~ M1 + Y1 + a*X
               Y2 ~ M1 + Y1 + b*M2 + cp*X "

Step1 <- SA_step1(
  lavoutput = obs_output,
  mod_obs = observed,
  mod_phant = phantom
)

phantom_assignment <- list(
  "CovM1X" = 0,
  "CovY1M1" = "CovY2M2",
  "CovY1X" = 0,
  "VarM1" = 1,
  "VarY1" = 1,
  "CovM1M2" = seq(0, .6, .1),
  "CovY1Y2" = "CovM1M2",
  "CovY1M2" = seq(-.6, .6, .1),
  "CovM1Y2" = "CovY1M2"
)
Step2 <- SA_step2(
  phantom_assignment = phantom_assignment,
  step1 = Step1
)
```

SA_step3 *Step 3 of sensitivity analysis function*

Description

SA_step3() computes the parameter estimates in your phantom model defined in step 1 for the different values provided.

Usage

```
SA_step3(step2, n)
```

Arguments

step2	The object returned from SA_step2.
n	The sample size.

Value

A list of parameter estimates from each test covariance matrix.

Examples

```
#' @examples
covmatrix <- matrix(c(
  0.25, 0.95, 0.43,
  0.95, 8.87, 2.66,
  0.43, 2.66, 10.86
), nrow = 3, byrow = TRUE)
colnames(covmatrix) <- c("X", "M2", "Y2")

# lavann syntax for observed model
observed <- " M2 ~ X
             Y2 ~ M2+X "

# lavaan output
obs_output <- lavaan::sem(model = observed, sample.cov = covmatrix, sample.nobs = 200)

# lavaan syntax for phantom variable model
phantom <- " M2 ~ M1 + Y1 + a*X
               Y2 ~ M1 + Y1 + b*M2 + cp*X "

Step1 <- SA_step1(
  lavoutput = obs_output,
  mod_obs = observed,
  mod_phant = phantom
)

phantom_assignment <- list(
  "CovM1X" = 0,
  "CovY1M1" = "CovY2M2",
  "CovY1X" = 0,
  "VarM1" = 1,
  "VarY1" = 1,
  "CovM1M2" = seq(.4, .6, .1),
  "CovY1Y2" = "CovM1M2",
  "CovY1M2" = seq(.1, .3, .1),
  "CovM1Y2" = "CovY1M2"
)
Step2 <- SA_step2(
  phantom_assignment = phantom_assignment,
  step1 = Step1
)
Step3 <- SA_step3(
  step2 = Step2,
```

```
  n = 200
)
```

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