

Package ‘rmedsem’

May 9, 2026

Title Statistical Mediation Analysis for SEMs

Version 1.0.0

Description Conducts mediation analysis for structural equation models (SEM) estimated with 'lavaan', 'blavaan', 'cSEM', or 'modsem'. Implements the Baron and Kenny (1986) <[doi:10.1037/0022-3514.51.6.1173](https://doi.org/10.1037/0022-3514.51.6.1173)> and Zhao, Lynch & Chen (2010) <[doi:10.1086/651257](https://doi.org/10.1086/651257)> approaches to determine the presence and type of mediation. Supports covariance-based SEM, partial least squares SEM, Bayesian SEM, and moderated mediation models. Reports indirect effects with standard errors from Sobel, Delta, Monte-Carlo, and bootstrap methods, along with effect size measures (RIT, RID).

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Encoding UTF-8

RoxygenNote 7.3.2

Imports lavaan, mvtnorm, ggplot2, dplyr, purrr, stats

URL <https://github.com/ihrke/rmedsem>, <https://ihrke.github.io/rmedsem/>

BugReports <https://github.com/ihrke/rmedsem/issues>

Depends R (>= 4.1.0)

LazyData true

Suggests blavaan, boot, cSEM, HDInterval, modsem, semPlot, rmarkdown, testthat (>= 3.0.0)

Config/testthat/edition 3

NeedsCompilation no

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Repository CRAN

Date/Publication 2026-03-16 16:50:02 UTC

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as.data.frame.rmedsem *Convert an rmedsem Object to a Data Frame*

Description

Convert an rmedsem Object to a Data Frame

Usage

```
## S3 method for class 'rmedsem'
as.data.frame(x, ...)
```

Arguments

x the rmedsem object
 ... additional arguments (currently unused)

Value

a data.frame

Examples

```
mod.txt <- "  
read ~ math  
science ~ read + math  
"  
mod <- lavaan::sem(mod.txt, data=rmedsem::hsbdemo)  
out <- rmedsem(mod, indep="math", med="read", dep="science")  
as.data.frame(out)
```

hsbdemo

High School and Beyond Demo Dataset

Description

High School and Beyond Demo Dataset

Usage

hsbdemo

Format

hsbdemo:

A data frame with 20 rows and 13 columns:

id Student ID

female

mchoice

Mate-Choice Survey Data from Trondheim

Description

Data from a survey on mate-choice in Trondheim.

Usage

mchoice

Format

mchoice:

A data frame with 1090 rows and 9 columns:

smv_attr_face How well does this describe you as a partner?, [1] very bad - [5] very well
smv_attr_body How well does this describe you as a partner?, [1] very bad - [5] very well
smvSexy How well does this describe you as a partner?, [1] very bad - [5] very well
ses_satis On the whole, I am satisfied with myself, [1] totally disagree - [5] totally agree
ses_qualities I feel that I have a number of good qualities, [1] totally disagree - [5] totally agree
ses_able_todo I am able to do things as well as most other people, [1] totally disagree - [5] totally agree
mwb_optimistic I have been feeling optimistic about the future, [1] never - [5] always
mwb_useful I have been feeling useful, [1] never - [5] always
mwb_energy I have had energy to spare, [1] never - [5] always
smv_kind ?, [1] ? - [5] ?
smv_caring ?, [1] ? - [5] ?
smv_understanding ?, [1] ? - [5] ?
smv_make_laughh ?, [1] ? - [5] ?
smv_funny ?, [1] ? - [5] ?
smv_sociable ?, [1] ? - [5] ?

plot.rmedsem

Plot an rmedsem Object

Description

Creates a visualization of the mediation analysis results. By default, produces a coefficient plot. Use `type = "effect"` for an effect size pie chart.

Usage

```
## S3 method for class 'rmedsem'
plot(x, type = c("coef", "effect"), ...)
```

Arguments

<code>x</code>	the rmedsem object
<code>type</code>	character; either "coef" (default) for a coefficient plot or "effect" for an effect size plot
<code>...</code>	additional arguments passed to <code>plot_coef()</code> or <code>plot_effect()</code>

Value

a ggplot object

Examples

```
mod.txt <- "  
read ~ math  
science ~ read + math  
"  
mod <- lavaan::sem(mod.txt, data=rmedsem::hsbdemo)  
out <- rmedsem(mod, indep="math", med="read", dep="science")  
plot(out)  
plot(out, type="effect")
```

plot_coef

Plot Coefficients for an rmedsem Object

Description

Plot Coefficients for an rmedsem Object

Usage

```
plot_coef(res)
```

Arguments

res the rmedsem object

Value

a ggplot object

Examples

```
mod.txt <- "  
read ~ math  
science ~ read + math  
"  
mod <- lavaan::sem(mod.txt, data=rmedsem::hsbdemo)  
out <- rmedsem(mod, indep="math", med="read", dep="science")  
plot_coef(out)
```

plot_effect *Plot Effect Sizes for an rmedsem Object*

Description

Plot Effect Sizes for an rmedsem Object

Usage

```
plot_effect(res, description = TRUE)
```

Arguments

res the rmedsem object
description logical, whether to add a description subtitle

Value

a ggplot object

Examples

```
mod.txt <- "  
read ~ math  
science ~ read + math  
"  
mod <- lavaan::sem(mod.txt, data=rmedsem::hsbdemo)  
out <- rmedsem(mod, indep="math", med="read", dep="science")  
plot_effect(out)
```

print.rmedsem *Print an rmedsem Object*

Description

Print an rmedsem Object

Usage

```
## S3 method for class 'rmedsem'  
print(x, digits = 3, indent = 3, ...)
```

Arguments

`x` the rmedsem object to print
`digits` an integer, number of digits to print in table
`indent` an integer, number of spaces to indent
`...` additional arguments (currently unused)

Value

the rmedsem object `x` (invisibly)

Examples

```

mod.txt <- "
read ~ math
science ~ read + math
"
mod <- lavaan::sem(mod.txt, data=rmedsem::hsbdemo)
out <- rmedsem(mod, indep="math", med="read", dep="science")
print(out)

```

 RID

Ratio of Indirect to Direct Effect (RID)

Description

Ratio of Indirect to Direct Effect (RID)

Usage

```

RID(res, ...)

## S3 method for class 'rmedsem'
RID(res, ...)

```

Arguments

`res` fitted rmedsem object
`...` additional arguments (currently unused)

Value

A numeric scalar giving the ratio of the indirect effect to the direct effect (indirect / direct).

Examples

```

mod.txt <- "
read ~ math
science ~ read + math
"
mod <- lavaan::sem(mod.txt, data=rmedsem::hsbdemo)
out <- rmedsem(mod, indep="math", med="read", dep="science")
RIT(out)

```

RIT

Ratio of Indirect to Total Effect (RIT)

Description

Ratio of Indirect to Total Effect (RIT)

Usage

```

RIT(res, ...)

## S3 method for class 'rmedsem'
RIT(res, ...)

```

Arguments

```

res          fitted rmedsem object
...         additional arguments (currently unused)

```

Value

A numeric scalar giving the ratio of the indirect effect to the total effect (indirect / total).

Examples

```

mod.txt <- "
read ~ math
science ~ read + math
"
mod <- lavaan::sem(mod.txt, data=rmedsem::hsbdemo)
out <- rmedsem(mod, indep="math", med="read", dep="science")
RIT(out)

```

Description

Conducts mediation analysis on a fitted SEM model using the Baron and Kenny (1986) and/or Zhao, Lynch & Chen (2010) approaches.

Usage

```
rmedsem(
  mod,
  indep,
  med,
  dep,
  approach = c("bk", "zlc"),
  p.threshold = 0.05,
  effect.size = c("RIT", "RID", "upsilon"),
  ...
)
```

Arguments

mod	a fitted SEM model object (from lavaan, blavaan, cSEM, or modsem)
indep	a string indicating the name of the independent variable
med	a string indicating the name of the mediator variable
dep	a string indicating the name of the dependent variable
approach	either "bk" or "zlc" or both c("bk", "zlc") (default)
p.threshold	a numeric giving the p-value threshold for significance
effect.size	character vector; one or more of "RIT", "RID", "upsilon"
...	additional arguments passed to methods

Value

an object of class rmedsem

Examples

```
mod.txt <- "
read ~ math
science ~ read + math
"
mod <- lavaan::sem(mod.txt, data=rmedsem::hsbdemo)
out <- rmedsem(mod, indep="math", med="read", dep="science")
out
```

rmedsem.blavaan *Mediation Analysis for Blavaan Models*

Description

Mediation Analysis for Blavaan Models

Usage

```
## S3 method for class 'blavaan'
rmedsem(
  mod,
  indep,
  med,
  dep,
  approach = c("bk", "zlc"),
  p.threshold = 0.05,
  effect.size = c("RIT", "RID", "epsilon"),
  ...
)
```

Arguments

mod	A fitted SEM model (blavaan). Note that the model has to be fit using <code>save.lvs=TRUE</code> if the mediation model contains latent variables.
indep	A string indicating the name of the independent variable in the model.
med	A string indicating the name of the mediator variable in the model.
dep	A string indicating the name of the dependent variable in the model.
approach	either 'bk' or 'zlc' or both <code>c("bk", "zlc")</code> (default)
p.threshold	A double giving the p-value for determining whether a path is significant or not
effect.size	calculate different effect-sizes; one or more of "RIT", "RID"
...	additional arguments (currently unused)

Value

A `rmedsem` structure containing the results from the analysis

Examples

```
## Not run:
# Requires blavaan and a MCMC backend (Stan/JAGS)
model02 <- "
# measurement model
ind60 =~ x1 + x2 + x3
dem60 =~ y1 + y2 + y3 + y4
dem65 =~ y5 + y6 + y7 + y8
```

```

# regressions
dem60 ~ ind60
dem65 ~ ind60 + dem60
"
mod <- blavaan::bsem(model02, data=lavaan::PoliticalDemocracy, std.lv=TRUE,
  meanstructure=TRUE, n.chains=1,
  save.lvs=TRUE, burnin=500, sample=500)
out <- rmedsem(mod, indep="ind60", med="dem60", dep="dem65")
print(out)

## End(Not run)

```

rmedsem.cSEMResults *Mediation Analysis for cSEM Models*

Description

Mediation Analysis for cSEM Models

Usage

```

## S3 method for class 'cSEMResults'
rmedsem(
  mod,
  indep,
  med,
  dep,
  approach = c("bk", "zlc"),
  p.threshold = 0.05,
  effect.size = c("RIT", "RID", "upsilon"),
  nbootstrap = 1000,
  ci.two.tailed = 0.95,
  ...
)

```

Arguments

mod	A fitted SEM model (cSEM).
indep	A string indicating the name of the independent variable in the model.
med	A string indicating the name of the mediator variable in the model.
dep	A string indicating the name of the dependent variable in the model.
approach	either 'bk' or 'zlc' or both c("bk", "zlc") (default)
p.threshold	A double giving the p-value for determining whether a path is significant or not
effect.size	calculate different effect-sizes; one or more of "RIT", "RID"
nbootstrap	number of bootstrap samples, default=1000
ci.two.tailed	A double giving the confidence level for two-tailed confidence intervals (default 0.95)
...	additional arguments (currently unused)

Value

A rmedsem structure containing the results from the analysis

rmedsem.lavaan	<i>Mediation Analysis for Lavaan Models</i>
----------------	---

Description

Mediation Analysis for Lavaan Models

Usage

```
## S3 method for class 'lavaan'
rmedsem(
  mod,
  indep,
  med,
  dep,
  approach = c("bk", "zlc"),
  p.threshold = 0.05,
  effect.size = c("RIT", "RID", "upsilon"),
  standardized = TRUE,
  mcreps = NULL,
  ci.two.tailed = 0.95,
  ...
)
```

Arguments

mod	A fitted SEM model (lavaan).
indep	A string indicating the name of the independent variable in the model.
med	A string indicating the name of the mediator variable in the model.
dep	A string indicating the name of the dependent variable in the model.
approach	either 'bk' or 'zlc' or both c("bk", "zlc") (default)
p.threshold	A double giving the p-value for determining whether a path is significant or not
effect.size	calculate different effect-sizes; one or more of "RIT", "RID"
standardized	A boolean indicating whether the coefficients should be standardized. The default value is FALSE.
mcreps	An integer determining the number of monte-carlo samples.
ci.two.tailed	A double giving the confidence level for two-tailed confidence intervals (default 0.95)
...	additional arguments (currently unused)

Value

A rmedsem structure containing the results from the analysis

Examples

```
mod.txt <- "
read ~ math
science ~ read + math
"
mod <- lavaan::sem(mod.txt, data=rmedsem::hsbdemo)
out <- rmedsem(mod, indep="math", med="read", dep="science",
              standardized=TRUE, mcreps=5000,
              approach = c("bk","zlc"))
print(out)
```

rmedsem.modsem

Mediation Analysis for Modsem Models

Description

Mediation Analysis for Modsem Models

Usage

```
## S3 method for class 'modsem'
rmedsem(
  mod,
  indep,
  med,
  dep,
  approach = c("bk", "zlc"),
  p.threshold = 0.05,
  effect.size = c("RIT", "RID", "upsilon"),
  moderator = NULL,
  standardized = TRUE,
  mcreps = NULL,
  ci.two.tailed = 0.95,
  ...
)
```

Arguments

mod	A fitted SEM model (modsem).
indep	A string indicating the name of the independent variable in the model.
med	A string indicating the name of the mediator variable in the model.
dep	A string indicating the name of the dependent variable in the model.

approach	either 'bk' or 'zlc' or both c("bk", "zlc") (default)
p.threshold	A double giving the p-value for determining whether a path is significant or not
effect.size	calculate different effect-sizes; one or more of "RIT", "RID"
moderator	A string indicating the name of the moderator variable in the model.
standardized	A boolean indicating whether the coefficients should be standardized. The default value is FALSE.
mcreps	An integer determining the number of monte-carlo samples.
ci.two.tailed	A double giving the confidence level for two-tailed confidence intervals (default 0.95)
...	additional arguments (currently unused)

Value

A rmedsem structure containing the results from the analysis

Examples

```
if (requireNamespace("modsem", quietly = TRUE)) {
  m <- "
  OwnLook =~ smv_attr_face + smv_attr_body + smvSexy
  SelfEst =~ ses_satis + ses_qualities + ses_able_todo
  MentWell =~ mwb_optimistic + mwb_useful + mwb_energy
  smv =~ smv_kind + smv_caring + smv_understanding +
    smv_make_laughh + smv_funny + smv_sociable
  SelfEst ~ OwnLook + smv + smv:OwnLook
  MentWell ~ OwnLook + SelfEst + smv + smv:OwnLook
  "

  est <- modsem::modsem(m, data = mchoice, method="lms")

  # mediated moderation
  rmedsem(indep="smv:OwnLook", dep="MentWell", med="SelfEst", mod=est)

  # moderated mediation
  rmedsem(indep="OwnLook", dep="MentWell", med="SelfEst", mod=est, moderator="smv")
}
```

summary.rmedsem

Summarize an rmedsem Object

Description

Prints the mediation analysis results to the console.

Usage

```
## S3 method for class 'rmedsem'
summary(object, ...)
```

Arguments

```
object          the rmedsem object
...             additional arguments passed to print.rmedsem()
```

Value

the rmedsem object (invisibly)

Examples

```
mod.txt <- "
read ~ math
science ~ read + math
"
mod <- lavaan::sem(mod.txt, data=rmedsem::hsbdemo)
out <- rmedsem(mod, indep="math", med="read", dep="science")
summary(out)
```

Upsilon

Upsilon Effect Size

Description

Returns the Upsilon effect size (Lachowicz, Preacher & Kelley, 2018), an R-squared-type measure representing the variance in Y explained indirectly by X through M.

Usage

```
Upsilon(res, ...)

## S3 method for class 'rmedsem'
Upsilon(res, adjusted = TRUE, ...)
```

Arguments

```
res            fitted rmedsem object
...           additional arguments (currently unused)
adjusted      logical; if TRUE (default), return the bias-adjusted estimator; if FALSE, return the unadjusted estimator
```

Value

A numeric scalar giving the Upsilon effect size, an R-squared-type measure of the variance in the dependent variable explained indirectly through the mediator.

Examples

```
mod.txt <- "
read ~ math
science ~ read + math
"
mod <- lavaan::sem(mod.txt, data=rmedsem::hsbdemo)
out <- rmedsem(mod, indep="math", med="read", dep="science",
  effect.size=c("RIT", "RID", "upsilon"))
Upsilon(out)
Upsilon(out, adjusted=FALSE)
```

workout

Fitness Center Survey Data from Trondheim

Description

Data from a survey in a fitness center in Trondheim.

Usage

```
workout
```

Format

workout:

A data frame with 246 rows and 12 columns:

age Age in years

lweight How important is following to workout- to loose weight

calories How important is following to workout- to burn calories

cweight How important is following to workout- to control my weight

body How important is following to workout- to have a good body

appear How important is following to workout- to improve my appearance

attract How important is following to workout- to look more attractive

muscle How important is following to workout- to develop my muscles

strength How important is following to workout- to get stronger

endur How important is following to workout- to increase my endurance

face How well does the following describe you as a person - attractive face

sexy How well does the following describe you as a person - sexy

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