Package 'regmedint'

October 15, 2025

Title Regression-Based Causal Mediation Analysis with Interaction and
Effect Modification Terms

Version 1.0.1

Description This is an extension of the regression-based causal mediation analysis first proposed by Valeri and VanderWeele (2013) <doi:10.1037/a0031034> and Valeri and VanderWeele (2015) <doi:10.1097/EDE.0000000000000253>). It supports including effect measure modification by covariates(treatment-covariate and mediator-covariate product terms in mediator and outcome regression models) as proposed by Li et al (2023) <doi:10.1097/EDE.0000000000001643>. It also accommodates the original 'SAS' macro and 'PROC CAUSALMED' procedure in 'SAS' when there is no effect measure modification. Linear and logistic models are supported for the mediator model. Linear, logistic, loglinear, Poisson, negative binomial, Cox, and accelerated failure time (exponential and Weibull) models are supported for the outcome model.

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Encoding UTF-8

LazyData true

Imports Deriv, MASS, Matrix, assertthat, sandwich, survival

Suggests boot, furrr, future, geepack, knitr, mice, mitools, modelr,
purrr, rlang, rmarkdown, stringr, testthat, tidyverse, magic,
formattable, kableExtra

RoxygenNote 7.3.3

VignetteBuilder knitr

URL https://kaz-yos.github.io/regmedint/

BugReports https://github.com/kaz-yos/regmedint/issues

Depends R (>= 2.10)

NeedsCompilation no

Author Kazuki Yoshida [ctb, aut] (ORCID:
<https://orcid.org/0000-0002-2030-3549>),
Yi Li [cre, aut] (ORCID: <https://orcid.org/0000-0002-9359-210X>),
Maya Mathur [ctb] (ORCID: <https://orcid.org/0000-0001-6698-2607>)

Maintainer Yi Li <yi.li10@mail.mcgill.ca>

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Contents

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regmedint-package   *regmedint: A package for regression-based causal mediation analysis*

Description

The package is an R implementation of regression-based closed-form causal mediation as originally described in Valeri & VanderWeele 2013 and Valeri & VanderWeele 2015 `https://www.hsph.harvard.edu/tyler-vanderweele/tools-and-tutorials/`. The earlier version is a sister program of the SAS macro. The current extended version (version 1.0 and later) supports effect modification by covariates (treatment-covariate and mediator-covariate product terms) in mediator and outcome models.

Fitting models

Use the regmedint function to fit models and set up regression-based causal mediation analysis.

Examining results

Several methods are available to examine the regmedint object. print summary coef confint

Author(s)

Maintainer: Yi Li <yi.li10@mail.mcgill.ca> (ORCID)

Authors:

- Kazuki Yoshida <kazukiyoshida@mail.harvard.edu> (ORCID) [contributor]

Other contributors:

- Maya Mathur (ORCID) [contributor]

See Also

Useful links:

- <https://kaz-yos.github.io/regmedint/>
- Report bugs at <https://github.com/kaz-yos/regmedint/issues>

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beta_hat   *Create a vector of coefficients from the mediator model (mreg)*

Description

This function extracts `coef` from `mreg_fit` and pads with zeros appropriately to create a named vector consistently having the following elements: `(Intercept)`, `avar`, `cvar` (this part is eliminated when `cvar = NULL`), `emm_ac_mreg` (this part is eliminated when `emm_ac_mreg = NULL`).

Usage

```
beta_hat(mreg, mreg_fit, avar, cvar, emm_ac_mreg = NULL)
```

Arguments

mreg	A character vector of length 1. Mediator regression type: `"linear"` or `"logistic"`.
mreg_fit	Model fit object for mreg (mediator model).
avar	A character vector of length 1. Treatment variable name.
cvar	A character vector of length > 0. Covariate names. Use `NULL` if there is no covariate. However, this is a highly suspicious situation. Even if `avar` is randomized, `mvar` is not. Thus, there are usually some confounder(s) to account for the common cause structure (confounding) between `mvar` and `yvar`.
emm_ac_mreg	A character vector of length > 0. Effect modifiers names. The covariate vector in treatment-covariate product term in the mediator model.

Value

A named numeric vector of coefficients.

---

calc_myreg   *Return mediation analysis functions given mediator and outcome mod-*
                              els specifications.

Description

This function returns functions that can be used to calculate the causal effect measures, given the mediator model fit (`mreg_fit`) and the outcome model fit (`yreg_fit`).

Usage

```
calc_myreg(
  mreg,
  mreg_fit,
  yreg,
  yreg_fit,
  avar,
  mvar,
  cvar,
  emm_ac_mreg,
  emm_ac_yreg,
  emm_mc_yreg,
  interaction
)
```

Arguments

mreg	A character vector of length 1. Mediator regression type: `"linear"` or `"logistic"`.
mreg_fit	Model fit from [fit_mreg](#)
yreg	A character vector of length 1. Outcome regression type: `"linear"`, `"logistic"`, `"loglinear"`, `"poisson"`, `"negbin"`, `"survCox"`, `"survAFT_exp"`, or `"survAFT_weibull"`.
yreg_fit	Model fit from [fit_yreg](#)
avar	A character vector of length 1. Treatment variable name.
mvar	A character vector of length 1. Mediator variable name.
cvar	A character vector of length > 0. Covariate names. Use `NULL` if there is no covariate. However, this is a highly suspicious situation. Even if `avar` is randomized, `mvar` is not. Thus, there are usually some confounder(s) to account for the common cause structure (confounding) between `mvar` and `yvar`.
emm_ac_mreg	A character vector of length > 0. Effect modifiers names. The covariate vector in treatment-covariate product term in the mediator model.
emm_ac_yreg	A character vector of length > 0. Effect modifiers names. The covariate vector in treatment-covariate product term in the outcome model.
emm_mc_yreg	A character vector of length > 0. Effect modifiers names. The covariate vector in mediator-covariate product term in outcome model.
interaction	A logical vector of length 1. The presence of treatment-mediator interaction in the outcome model. Default to TRUE.

Value

A list containing two functions. The first is for calculating point estimates. The second is for calculating the correspoding

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calc_myreg_mreg_linear_yreg_linear

Create calculators for effects and se (mreg linear / yreg linear)

Description

Construct functions for the conditional effect estimates and their standard errors in the mreg linear / yreg linear setting. Internally, this function deconstructs model objects and feeds parameter estiamtes to the internal worker functions `calc_myreg_mreg_linear_yreg_linear_est` and `calc_myreg_mreg_linear_yreg_linear_se`.

Usage

```
calc_myreg_mreg_linear_yreg_linear(
  mreg,
  mreg_fit,
  yreg,
  yreg_fit,
  avar,
  mvar,
  cvar,
  emm_ac_mreg,
  emm_ac_yreg,
  emm_mc_yreg,
  interaction
)
```

Arguments

mreg	A character vector of length 1. Mediator regression type: `"linear"` or `"logistic"`.
mreg_fit	Model fit from fit_mreg
yreg	A character vector of length 1. Outcome regression type: `"linear"`, `"logistic"`, `"loglinear"`, `"poisson"`, `"negbin"`, `"survCox"`, `"survAFT_exp"`, or `"survAFT_weibull"`.
yreg_fit	Model fit from fit_yreg
avar	A character vector of length 1. Treatment variable name.
mvar	A character vector of length 1. Mediator variable name.
cvar	A character vector of length > 0. Covariate names. Use `NULL` if there is no covariate. However, this is a highly suspicious situation. Even if `avar` is randomized, `mvar` is not. Thus, there are usually some confounder(s) to account for the common cause structure (confounding) between `mvar` and `yvar`.
emm_ac_mreg	A character vector of length > 0. Effect modifiers names. The covariate vector in treatment-covariate product term in the mediator model.
emm_ac_yreg	A character vector of length > 0. Effect modifiers names. The covariate vector in treatment-covariate product term in the outcome model.

emm_mc_yreg	A character vector of length > 0. Effect modifiers names. The covariate vector in mediator-covariate product term in outcome model.
interaction	A logical vector of length 1. The presence of treatment-mediator interaction in the outcome model. Default to TRUE.

Value

A list containing a function for effect estimates and a function for corresponding standard errors.

---

calc_myreg_mreg_linear_yreg_logistic

Create calculators for effects and se (mreg linear / yreg logistic)

Description

Construct functions for the conditional effect estimates and their standard errors in the mreg linear / yreg logistic setting. Internally, this function deconstructs model objects and feeds parameter estimates to the internal worker functions calc_myreg_mreg_linear_yreg_logistic_est and calc_myreg_mreg_linear_yreg_logistic_se.

Usage

```
calc_myreg_mreg_linear_yreg_logistic(
  mreg,
  mreg_fit,
  yreg,
  yreg_fit,
  avar,
  mvar,
  cvar,
  emm_ac_mreg,
  emm_ac_yreg,
  emm_mc_yreg,
  interaction
)
```

Arguments

mreg	A character vector of length 1. Mediator regression type: "linear" or "logistic".
mreg_fit	Model fit from fit_mreg
yreg	A character vector of length 1. Outcome regression type: "linear", "logistic", "loglinear", "poisson", "negbin", "survCox", "survAFT_exp", or "survAFT_weibull".
yreg_fit	Model fit from fit_yreg
avar	A character vector of length 1. Treatment variable name.
mvar	A character vector of length 1. Mediator variable name.
cvar	A character vector of length > 0. Covariate names. Use NULL if there is no covariate. However, this is a highly suspicious situation. Even if avar is randomized, mvar is not. Thus, there are usually some confounder(s) to account for the common cause structure (confounding) between mvar and yvar.

emm_ac_mreg	A character vector of length > 0. Effect modifiers names. The covariate vector in treatment-covariate product term in the mediator model.
emm_ac_yreg	A character vector of length > 0. Effect modifiers names. The covariate vector in treatment-covariate product term in the outcome model.
emm_mc_yreg	A character vector of length > 0. Effect modifiers names. The covariate vector in mediator-covariate product term in outcome model.
interaction	A logical vector of length 1. The presence of treatment-mediator interaction in the outcome model. Default to TRUE.

Value

A list containing a function for effect estimates and a function for corresponding standard errors.

---

calc_myreg_mreg_logistic_yreg_linear

Create calculators for effects and se (mreg logistic / yreg linear)

Description

Construct functions for the conditional effect estimates and their standard errors in the mreg logistic / yreg linear setting. Internally, this function deconstructs model objects and feeds parameter estimates to the internal worker functions calc_myreg_mreg_logistic_yreg_linear_est and calc_myreg_mreg_logistic_yreg_linear_se.

Usage

```
calc_myreg_mreg_logistic_yreg_linear(
  mreg,
  mreg_fit,
  yreg,
  yreg_fit,
  avar,
  mvar,
  cvar,
  emm_ac_mreg,
  emm_ac_yreg,
  emm_mc_yreg,
  interaction
)
```

Arguments

mreg	A character vector of length 1. Mediator regression type: "linear" or "logistic".
mreg_fit	Model fit from fit_mreg
yreg	A character vector of length 1. Outcome regression type: "linear", "logistic", "loglinear", "poisson", "negbin", "survCox", "survAFT_exp", or "survAFT_weibull".
yreg_fit	Model fit from fit_yreg
avar	A character vector of length 1. Treatment variable name.
mvar	A character vector of length 1. Mediator variable name.

cvar   A character vector of length > 0. Covariate names. Use NULL if there is no
                    covariate. However, this is a highly suspicious situation. Even if avar is ran-
                    domized, mvar is not. Thus, there are usually some confounder(s) to account for
                    the common cause structure (confounding) between mvar and yvar.

emm_ac_mreg   A character vector of length > 0. Effect modifiers names. The covariate vector
                    in treatment-covariate product term in the mediator model.

emm_ac_yreg   A character vector of length > 0. Effect modifiers names. The covariate vector
                    in treatment-covariate product term in the outcome model.

emm_mc_yreg   A character vector of length > 0. Effect modifiers names. The covariate vector
                    in mediator-covariate product term in outcome model.

interaction   A logical vector of length 1. The presence of treatment-mediator interaction in
                    the outcome model. Default to TRUE.

Value

A list containing a function for effect estimates and a function for corresponding standard errors.

---

calc_myreg_mreg_logistic_yreg_logistic

Create calculators for effects and se (mreg logistic / yreg logistic)

Description

Construct functions for the conditional effect estimates and their standard errors in the mreg logistic
/ yreg logistic setting. Internally, this function deconstructs model objects and feeds parameter
estimates to the internal worker functions calc_myreg_mreg_logistic_yreg_logistic_est and
calc_myreg_mreg_logistic_yreg_logistic_se.

Usage

```
calc_myreg_mreg_logistic_yreg_logistic(
  mreg,
  mreg_fit,
  yreg,
  yreg_fit,
  avar,
  mvar,
  cvar,
  emm_ac_mreg,
  emm_ac_yreg,
  emm_mc_yreg,
  interaction
)
```

Arguments

mreg   A character vector of length 1. Mediator regression type: ″linear″ or ″logistic″.

mreg_fit   Model fit from fit_mreg

yreg   A character vector of length 1. Outcome regression type: ″linear″, ″logistic″,
                    ″loglinear″, ″poisson″, ″negbin″, ″survCox″, ″survAFT_exp″, or ″survAFT_weibull″.

yreg_fit	Model fit from fit_yreg
avar	A character vector of length 1. Treatment variable name.
mvar	A character vector of length 1. Mediator variable name.
cvar	A character vector of length > 0. Covariate names. Use NULL if there is no covariate. However, this is a highly suspicious situation. Even if avar is randomized, mvar is not. Thus, there are usually some confounder(s) to account for the common cause structure (confounding) between mvar and yvar.
emm_ac_mreg	A character vector of length > 0. Effect modifiers names. The covariate vector in treatment-covariate product term in the mediator model.
emm_ac_yreg	A character vector of length > 0. Effect modifiers names. The covariate vector in treatment-covariate product term in the outcome model.
emm_mc_yreg	A character vector of length > 0. Effect modifiers names. The covariate vector in mediator-covariate product term in outcome model.
interaction	A logical vector of length 1. The presence of treatment-mediator interaction in the outcome model. Default to TRUE.

Value

A list containing a function for effect estimates and a function for corresponding standard errors.

---

coef.regmedint	*Extract point estimates.*

Description

Extract point estimates evaluated at a0, a1, m_cde, and c_cond.

Usage

```
## S3 method for class 'regmedint'
coef(object, a0 = NULL, a1 = NULL, m_cde = NULL, c_cond = NULL, ...)
```

Arguments

object	An object of the regmedint class.
a0	A numeric vector of length 1
a1	A numeric vector of length 1
m_cde	A numeric vector of length 1 The mediator value at which the controlled direct effect (CDE) conditional on the adjustment covariates is evaluated. If not provided, the default value supplied to the call to regmedint will be used. Only the CDE is affected.
c_cond	A numeric vector of the same length as cvar. A set of covariate values at which the conditional natural effects are evaluated.
...	For compatibility with the generic. Ignored.

Value

A numeric vector of point estimates.

Examples

```
library(regmedint)
data(vv2015)
regmedint_obj <- regmedint(data = vv2015,
                           ## Variables
                           yvar = "y",
                           avar = "x",
                           mvar = "m",
                           cvar = c("c"),
                           eventvar = "event",
                           ## Values at which effects are evaluated
                           a0 = 0,
                           a1 = 1,
                           m_cde = 1,
                           c_cond = 0.5,
                           ## Model types
                           mreg = "logistic",
                           yreg = "survAFT_weibull",
                           ## Additional specification
                           interaction = TRUE,
                           casecontrol = FALSE)
coef(regmedint_obj)
## Evaluate at different values
coef(regmedint_obj, m_cde = 0, c_cond = 1)
```

---

coef.summary_regmedint

Extract the result matrix from a summary_regmedint object.

Description

Extract the result matrix from a summary_regmedint object.

Usage

```
## S3 method for class 'summary_regmedint'
coef(object, ...)
```

Arguments

object   An object with a class of summary_regmedint.

...   For compatibility with the generic.

Value

A matrix populated with results.

Examples

```
library(regmedint)
data(vv2015)
regmedint_obj <- regmedint(data = vv2015,
                           ## Variables
                           yvar = "y",
                           avar = "x",
                           mvar = "m",
                           cvar = c("c"),
                           eventvar = "event",
                           ## Values at which effects are evaluated
                           a0 = 0,
                           a1 = 1,
                           m_cde = 1,
                           c_cond = 0.5,
                           ## Model types
                           mreg = "logistic",
                           yreg = "survAFT_weibull",
                           ## Additional specification
                           interaction = TRUE,
                           casecontrol = FALSE)
coef(summary(regmedint_obj))
```

---

confint.regmedint	*Confidence intervals for mediation prameter estimates.*

Description

Construct Wald approximate confidence intervals for the quantities of interest.

Usage

```
## S3 method for class 'regmedint'
confint(
  object,
  parm = NULL,
  level = 0.95,
  a0 = NULL,
  a1 = NULL,
  m_cde = NULL,
  c_cond = NULL,
  ...
)
```

Arguments

object	An object of the [regmedint](#) class.
parm	For compatibility with generic. Ignored.
level	A numeric vector of length one. Requested confidence level. Defaults to 0.95.
a0	A numeric vector of length 1

a1   A numeric vector of length 1

m_cde   A numeric vector of length 1 The mediator value at which the controlled direct
                            effect (CDE) conditional on the adjustment covariates is evaluated. If not pro-
                            vided, the default value supplied to the call to regmedint will be used. Only the
                            CDE is affected.

c_cond   A numeric vector of the same length as cvar. A set of covariate values at which
                            the conditional natural effects are evaluated.

...   For compatibility with generic.

Value

A numeric matrix of the lower limit and upper limit.

Examples

```
library(regmedint)
data(vv2015)
regmedint_obj <- regmedint(data = vv2015,
                           ## Variables
                           yvar = "y",
                           avar = "x",
                           mvar = "m",
                           cvar = c("c"),
                           eventvar = "event",
                           ## Values at which effects are evaluated
                           a0 = 0,
                           a1 = 1,
                           m_cde = 1,
                           c_cond = 0.5,
                           ## Model types
                           mreg = "logistic",
                           yreg = "survAFT_weibull",
                           ## Additional specification
                           interaction = TRUE,
                           casecontrol = FALSE)
confint(regmedint_obj)
## Evaluate at different values
confint(regmedint_obj, m_cde = 0, c_cond = 1)
## Change confidence level
confint(regmedint_obj, m_cde = 0, c_cond = 1, level = 0.99)
```

---

fit_mreg   *Fit a model for the mediator given the treatment and covariates.*

Description

lm is called if mreg = "linear". glm is called with family = binomial() if mreg = "logistic".

Usage

```
fit_mreg(mreg, data, avar, mvar, cvar, emm_ac_mreg = NULL)
```

Arguments

mreg	A character vector of length 1. Mediator regression type: "linear" or "logistic".
data	Data frame containing the following relevant variables.
avar	A character vector of length 1. Treatment variable name.
mvar	A character vector of length 1. Mediator variable name.
cvar	A character vector of length > 0. Covariate names. Use NULL if there is no covariate. However, this is a highly suspicious situation. Even if avar is randomized, mvar is not. Thus, there are usually some confounder(s) to account for the common cause structure (confounding) between mvar and yvar.
emm_ac_mreg	A character vector of length > 0. Effect modifiers names. The covariate vector in treatment-covariate product term in the mediator model.

Value

A regression object of class lm (linear) or glm (logistic)

---

fit_yreg	*Fit a model for the outcome given the treatment, mediator, and covariates.*

Description

The outcome model type yreg can be one of the following "linear", "logistic", "loglinear" (implemented as modified Poisson), "poisson", "negbin", "survCox", "survAFT_exp", or "survAFT_weibull".

Usage

```
fit_yreg(
  yreg,
  data,
  yvar,
  avar,
  mvar,
  cvar,
  emm_ac_yreg = NULL,
  emm_mc_yreg = NULL,
  eventvar,
  interaction
)
```

Arguments

yreg	A character vector of length 1. Outcome regression type: "linear", "logistic", "loglinear", "poisson", "negbin", "survCox", "survAFT_exp", or "survAFT_weibull".
data	Data frame containing the following relevant variables.
yvar	A character vector of length 1. Outcome variable name. It should be the time variable for the survival outcome.
avar	A character vector of length 1. Treatment variable name.

mvar	A character vector of length 1. Mediator variable name.
cvar	A character vector of length > 0. Covariate names. Use NULL if there is no covariate. However, this is a highly suspicious situation. Even if avar is randomized, mvar is not. Thus, there are usually some confounder(s) to account for the common cause structure (confounding) between mvar and yvar.
emm_ac_yreg	A character vector of length > 0. Effect modifiers names. The covariate vector in treatment-covariate product term in the outcome model.
emm_mc_yreg	A character vector of length > 0. Effect modifiers names. The covariate vector in mediator-covariate product term in outcome model.
eventvar	An character vector of length 1. Only required for survival outcome regression models. Note that the coding is 1 for event and 0 for censoring, following the R survival package convention.
interaction	A logical vector of length 1. The presence of treatment-mediator interaction in the outcome model. Default to TRUE.

Details

The outcome regression functions to be called are the following:

- "linear" lm
- "logistic" glm
- "loglinear" glm (modified Poisson)
- "poisson" glm
- "negbin" glm.nb
- "survCox" coxph
- "survAFT_exp" survreg
- "survAFT_weibull" survreg

Value

Model fit object from on of the above regression functions.

---

grad_prop_med_yreg_linear

Calculate the gradient of the proportion mediated for yreg linear.

Description

Calculate the gradient of the proportion mediated for yreg linear case.

Usage

```
grad_prop_med_yreg_linear(pnde, tnie)
```

Arguments

pnde	A numeric vector of length one. Pure natural direct effect.
tnie	A numeric vector of length one. Total natural indirect effect.

Value

A numeric vector of length two. Gradient of the proportion mediated with respect to pnde and tnie.

---

grad_prop_med_yreg_logistic

Calculate the gradient of the proportion mediated for yreg logistic.

Description

Calculate the gradient of the proportion mediated for yreg logistic case.

Usage

```
grad_prop_med_yreg_logistic(pnde, tnie)
```

Arguments

pnde	A numeric vector of length one. Pure natural direct effect.
tnie	A numeric vector of length one. Total natural indirect effect.

Value

A numeric vector of length two. Gradient of the proportion mediated with respect to pnde and tnie.

---

new_regmedint *Low level constructor for a regmedint S3 class object.*

Description

This is not a user function and meant to be executed within the regmedint function after validatingthe arguments.

Usage

```
new_regmedint(
  data,
  yvar,
  avar,
  mvar,
  cvar,
  emm_ac_mreg,
  emm_ac_yreg,
  emm_mc_yreg,
  eventvar,
  a0,
  a1,
  m_cde,
  c_cond,
  yreg,
```

```
    mreg,
    interaction,
    casecontrol
)
```

Arguments

data	Data frame containing the following relevant variables.
yvar	A character vector of length 1. Outcome variable name. It should be the time variable for the survival outcome.
avar	A character vector of length 1. Treatment variable name.
mvar	A character vector of length 1. Mediator variable name.
cvar	A character vector of length > 0. Covariate names. Use NULL if there is no covariate. However, this is a highly suspicious situation. Even if avar is randomized, mvar is not. Thus, there are usually some confounder(s) to account for the common cause structure (confounding) between mvar and yvar.
emm_ac_mreg	A character vector of length > 0. Effect modifiers names. The covariate vector in treatment-covariate product term in the mediator model.
emm_ac_yreg	A character vector of length > 0. Effect modifiers names. The covariate vector in treatment-covariate product term in the outcome model.
emm_mc_yreg	A character vector of length > 0. Effect modifiers names. The covariate vector in mediator-covariate product term in outcome model.
eventvar	An character vector of length 1. Only required for survival outcome regression models. Note that the coding is 1 for event and 0 for censoring, following the R survival package convention.
a0	A numeric vector of length 1. The reference level of treatment variable that is considered "untreated" or "unexposed".
a1	A numeric vector of length 1.
m_cde	A numeric vector of length 1. Mediator level at which controlled direct effect is evaluated at.
c_cond	A numeric vector of the same length as cvar. Covariate levels at which natural direct and indirect effects are evaluated at.
yreg	A character vector of length 1. Outcome regression type: "linear", "logistic", "loglinear", "poisson", "negbin", "survCox", "survAFT_exp", or "survAFT_weibull".
mreg	A character vector of length 1. Mediator regression type: "linear" or "logistic".
interaction	A logical vector of length 1. The presence of treatment-mediator interaction in the outcome model. Default to TRUE.
casecontrol	A logical vector of length 1. Default to FALSE. Whether data comes from a case-control study.

Value

A regmedint object.

---

print.regmedint *print method for regmedint object*

Description

Print the `mreg_fit`, `yreg_fit`, and the mediation analysis effect estimates.

Usage

```
## S3 method for class 'regmedint'
print(
  x,
  a0 = NULL,
  a1 = NULL,
  m_cde = NULL,
  c_cond = NULL,
  args_mreg_fit = list(),
  args_yreg_fit = list(),
  ...
)
```

Arguments

x	An object of the [regmedint](#) class.
a0	A numeric vector of length 1
a1	A numeric vector of length 1
m_cde	A numeric vector of length 1 The mediator value at which the controlled direct effect (CDE) conditional on the adjustment covariates is evaluated. If not provided, the default value supplied to the call to [regmedint](#) will be used. Only the CDE is affected.
c_cond	A numeric vector of the same length as cvar. A set of covariate values at which the conditional natural effects are evaluated.
args_mreg_fit	A named list of argument to be passed to the method for the `mreg_fit` object.
args_yreg_fit	A named list of argument to be passed to the method for the `mreg_fit` object.
...	For compatibility with the generic. Ignored.

Value

Invisibly return the `regmedint` class object as is.

Examples

```
library(regmedint)
data(vv2015)
regmedint_obj <- regmedint(data = vv2015,
                           ## Variables
                           yvar = "y",
                           avar = "x",
                           mvar = "m",
                           cvar = c("c"),
```

```
                            eventvar = "event",
                            ## Values at which effects are evaluated
                            a0 = 0,
                            a1 = 1,
                            m_cde = 1,
                            c_cond = 0.5,
                            ## Model types
                            mreg = "logistic",
                            yreg = "survAFT_weibull",
                            ## Additional specification
                            interaction = TRUE,
                            casecontrol = FALSE)
## Implicit printing
regmedint_obj
## Explicit printing
print(regmedint_obj)
## Evaluate at different values
print(regmedint_obj, m_cde = 0, c_cond = 1)
```

---

print.summary_regmedint

Print method for summary objects from summary.regmedint

Description

Print results contained in a summary_regmedint object with additional explanation regarding the evaluation settings.

Usage

```
## S3 method for class 'summary_regmedint'
print(x, ...)
```

Arguments

x	An object of the class summary_regmedint.
...	For compatibility with the generic function.

Value

Invisibly return the first argument.

Examples

```
library(regmedint)
data(vv2015)
regmedint_obj <- regmedint(data = vv2015,
                           ## Variables
                           yvar = "y",
                           avar = "x",
                           mvar = "m",
                           cvar = c("c"),
```

```
                                eventvar = "event",
                                ## Values at which effects are evaluated
                                a0 = 0,
                                a1 = 1,
                                m_cde = 1,
                                c_cond = 0.5,
                                ## Model types
                                mreg = "logistic",
                                yreg = "survAFT_weibull",
                                ## Additional specification
                                interaction = TRUE,
                                casecontrol = FALSE)
## Implicit printing
summary(regmedint_obj)
## Explicit printing
print(summary(regmedint_obj))
```

---

prop_med_yreg_linear   *Calculate the proportion mediated for yreg linear.*

Description

Calculate the proportion mediated on the mean difference scale.

Usage

```
prop_med_yreg_linear(pnde, tnie)
```

Arguments

pnde	Pure natural direct effect.
tnie	Total natural indirect effect.

Value

Proportion mediated value.

---

prop_med_yreg_logistic
                        Calculate the proportion mediated for yreg logistic.

Description

Calculate the approximate proportion mediated on the risk difference scale.

Usage

```
prop_med_yreg_logistic(pnde, tnie)
```

Arguments

pnde	Pure natural direct effect on the log scale.
tnie	Total natural indirect effect on the log scale.

Value

Proportion mediated value.

---

regmedint	*Conduct regression-based causal mediation analysis*

Description

This is a user-interface for regression-based causal mediation analysis as described in Valeri & VanderWeele 2013 and Valeri & VanderWeele 2015.

Usage

```
regmedint(
  data,
  yvar,
  avar,
  mvar,
  cvar,
  emm_ac_mreg = NULL,
  emm_ac_yreg = NULL,
  emm_mc_yreg = NULL,
  eventvar = NULL,
  a0,
  a1,
  m_cde,
  c_cond,
  mreg,
  yreg,
  interaction = TRUE,
  casecontrol = FALSE,
  na_omit = FALSE
)
```

Arguments

data	Data frame containing the following relevant variables.
yvar	A character vector of length 1. Outcome variable name. It should be the time variable for the survival outcome.
avar	A character vector of length 1. Treatment variable name.
mvar	A character vector of length 1. Mediator variable name.
cvar	A character vector of length > 0. Covariate names. Use NULL if there is no covariate. However, this is a highly suspicious situation. Even if avar is randomized, mvar is not. Thus, there are usually some confounder(s) to account for the common cause structure (confounding) between mvar and yvar.

emm_ac_mreg	A character vector of length > 0. Effect modifiers names. The covariate vector in treatment-covariate product term in the mediator model.
emm_ac_yreg	A character vector of length > 0. Effect modifiers names. The covariate vector in treatment-covariate product term in the outcome model.
emm_mc_yreg	A character vector of length > 0. Effect modifiers names. The covariate vector in mediator-covariate product term in outcome model.
eventvar	An character vector of length 1. Only required for survival outcome regression models. Note that the coding is 1 for event and 0 for censoring, following the R survival package convention.
a0	A numeric vector of length 1. The reference level of treatment variable that is considered "untreated" or "unexposed".
a1	A numeric vector of length 1.
m_cde	A numeric vector of length 1. Mediator level at which controlled direct effect is evaluated at.
c_cond	A numeric vector of the same length as cvar. Covariate levels at which natural direct and indirect effects are evaluated at.
mreg	A character vector of length 1. Mediator regression type: "linear" or "logistic".
yreg	A character vector of length 1. Outcome regression type: "linear", "logistic", "loglinear", "poisson", "negbin", "survCox", "survAFT_exp", or "survAFT_weibull".
interaction	A logical vector of length 1. The presence of treatment-mediator interaction in the outcome model. Default to TRUE.
casecontrol	A logical vector of length 1. Default to FALSE. Whether data comes from a case-control study.
na_omit	A logical vector of length 1. Default to FALSE. Whether to remove NAs in the columns of interest before fitting the models.

Value

regmedint object, which is a list containing the mediator regression object, the outcome regression object, and the regression-based mediation results.

Examples

```
library(regmedint)
data(vv2015)
regmedint_obj1 <- regmedint(data = vv2015,
                            ## Variables
                            yvar = "y",
                            avar = "x",
                            mvar = "m",
                            cvar = c("c"),
                            eventvar = "event",
                            ## Values at which effects are evaluated
                            a0 = 0,
                            a1 = 1,
                            m_cde = 1,
                            c_cond = 3,
                            ## Model types
                            mreg = "logistic",
                            yreg = "survAFT_weibull",
                            ## Additional specification
```

```
                              interaction = TRUE,
                              casecontrol = FALSE)
summary(regmedint_obj1)

regmedint_obj2 <- regmedint(data = vv2015,
                            ## Variables
                            yvar = "y",
                            avar = "x",
                            mvar = "m",
                            cvar = c("c"),
                            emm_ac_mreg = c("c"),
                            emm_ac_yreg = c("c"),
                            emm_mc_yreg = c("c"),
                            eventvar = "event",
                            ## Values at which effects are evaluated
                            a0 = 0,
                            a1 = 1,
                            m_cde = 1,
                            c_cond = 3,
                            ## Model types
                            mreg = "logistic",
                            yreg = "survAFT_weibull",
                            ## Additional specification
                            interaction = TRUE,
                            casecontrol = FALSE)
summary(regmedint_obj2)
```

---

report_missing   *Report variables with missing data*

Description

Report the number of missing observations for each variables of interest relevant for the analysis

Usage

```
report_missing(data, yvar, avar, mvar, cvar, eventvar)
```

Arguments

data	Data frame containing the following relevant variables.
yvar	A character vector of length 1. Outcome variable name. It should be the time variable for the survival outcome.
avar	A character vector of length 1. Treatment variable name.
mvar	A character vector of length 1. Mediator variable name.
cvar	A character vector of length > 0. Covariate names. Use NULL if there is no covariate. However, this is a highly suspicious situation. Even if avar is randomized, mvar is not. Thus, there are usually some confounder(s) to account for the common cause structure (confounding) between mvar and yvar.

eventvar   An character vector of length 1. Only required for survival outcome regression models. Note that the coding is 1 for event and 0 for censoring, following the R survival package convention.

Value

No return value, called for side effects.

---

summary.regmedint   *summary method for regmedint object*

Description

Summarize the `mreg_fit`, `yreg_fit`, and the mediation analysis effect estimates.

Usage

```
## S3 method for class 'regmedint'
summary(
  object,
  a0 = NULL,
  a1 = NULL,
  m_cde = NULL,
  c_cond = NULL,
  args_mreg_fit = list(),
  args_yreg_fit = list(),
  exponentiate = FALSE,
  level = 0.95,
  ...
)
```

Arguments

object	An object of the [regmedint](#) class.
a0	A numeric vector of length 1
a1	A numeric vector of length 1
m_cde	A numeric vector of length 1 The mediator value at which the controlled direct effect (CDE) conditional on the adjustment covariates is evaluated. If not provided, the default value supplied to the call to [regmedint](#) will be used. Only the CDE is affected.
c_cond	A numeric vector of the same length as `cvar`. A set of covariate values at which the conditional natural effects are evaluated.
args_mreg_fit	A named list of argument to be passed to the method for the `mreg_fit` object.
args_yreg_fit	A named list of argument to be passed to the method for the `mreg_fit` object.
exponentiate	Whether to add exponentiated point and confidence limit estimates. When `yreg` = "linear", it is ignored.
level	Confidence level for the confidence intervals.
...	For compatibility with the generic. Ignored.

Value

A `summary_regmedint` object, which is a list containing the summary objects of the `mreg_fit` and the `yreg_fit` as well as the mediation analysis results.

Examples

```
library(regmedint)
data(vv2015)
regmedint_obj <- regmedint(data = vv2015,
                          ## Variables
                          yvar = "y",
                          avar = "x",
                          mvar = "m",
                          cvar = c("c"),
                          eventvar = "event",
                          ## Values at which effects are evaluated
                          a0 = 0,
                          a1 = 1,
                          m_cde = 1,
                          c_cond = 0.5,
                          ## Model types
                          mreg = "logistic",
                          yreg = "survAFT_weibull",
                          ## Additional specification
                          interaction = TRUE,
                          casecontrol = FALSE)
## Detailed result with summary
summary(regmedint_obj)
## Add exponentiate results for non-linear outcome models
summary(regmedint_obj, exponentiate = TRUE)
## Evaluate at different values
summary(regmedint_obj, m_cde = 0, c_cond = 1)
## Change confidence level
summary(regmedint_obj, m_cde = 0, c_cond = 1, level = 0.99)
```

---

summary.regmedint_mod_poisson

Summary with robust sandwich variance estimator for modified Poisson

---

Description

This is a version of `summary.glm` modified to use the robust variance estimator `sandwich`.

Usage

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

Arguments

object	A model object of the class `regmedint_mod_poisson`
...	For compatibility with the generic.

Value

An object of the class `summary.glm`

---

theta_hat	*Create a vector of coefficients from the outcome model (yreg)*

Description

This function extracts [coef](#) from `yreg_fit` and 3s with zeros appropriately to create a named vector consistently having the following elements: `(Intercept)` (a zero element is added for `yreg = "survCox"` for which no intercept is estimated (the baseline hazard is left unspecified)), `avar`, `mvar`, `avar:mvar` (a zero element is added when `interaction = FALSE`). `cvar` (this part is eliminated when `cvar = NULL`), `emm_ac_yreg` (this part is eliminated when `emm_ac_yreg = NULL`), `emm_mc_yreg` (this part is eliminated when `emm_mc_yreg = NULL`).

Usage

```
theta_hat(
  yreg,
  yreg_fit,
  avar,
  mvar,
  cvar,
  emm_ac_yreg = NULL,
  emm_mc_yreg = NULL,
  interaction
)
```

Arguments

yreg	A character vector of length 1. Outcome regression type: `"linear"`, `"logistic"`, `"loglinear"`, `"poisson"`, `"negbin"`, `"survCox"`, `"survAFT_exp"`, or `"survAFT_weibull"`.
yreg_fit	Model fit object for yreg (outcome model).
avar	A character vector of length 1. Treatment variable name.
mvar	A character vector of length 1. Mediator variable name.
cvar	A character vector of length > 0. Covariate names. Use `NULL` if there is no covariate. However, this is a highly suspicious situation. Even if `avar` is randomized, `mvar` is not. Thus, there are usually some confounder(s) to account for the common cause structure (confounding) between `mvar` and `yvar`.
emm_ac_yreg	A character vector of length > 0. Effect modifiers names. The covariate vector in treatment-covariate product term in the outcome model.
emm_mc_yreg	A character vector of length > 0. Effect modifiers names. The covariate vector in mediator-covariate product term in outcome model.
interaction	A logical vector of length 1. The presence of treatment-mediator interaction in the outcome model. Default to TRUE.

Value

A named numeric vector of coefficients.

---

validate_args   *Validate arguments to regmedint before passing to other functions*

Description

Internal functions (usually) do not validate arguments, thus, we need to make sure informative errors are raised when the arguments are not safe for subsequent computation.

Usage

```
validate_args(
  data,
  yvar,
  avar,
  mvar,
  cvar,
  emm_ac_mreg,
  emm_ac_yreg,
  emm_mc_yreg,
  eventvar,
  a0,
  a1,
  m_cde,
  c_cond,
  mreg,
  yreg,
  interaction,
  casecontrol
)
```

Arguments

data	Data frame containing the following relevant variables.
yvar	A character vector of length 1. Outcome variable name. It should be the time variable for the survival outcome.
avar	A character vector of length 1. Treatment variable name.
mvar	A character vector of length 1. Mediator variable name.
cvar	A character vector of length > 0. Covariate names. Use NULL if there is no covariate. However, this is a highly suspicious situation. Even if avar is randomized, mvar is not. Thus, there are usually some confounder(s) to account for the common cause structure (confounding) between mvar and yvar.
emm_ac_mreg	A character vector of length > 0. Effect modifiers names. The covariate vector in treatment-covariate product term in the mediator model.
emm_ac_yreg	A character vector of length > 0. Effect modifiers names. The covariate vector in treatment-covariate product term in the outcome model.
emm_mc_yreg	A character vector of length > 0. Effect modifiers names. The covariate vector in mediator-covariate product term in outcome model.

eventvar	An character vector of length 1. Only required for survival outcome regression models. Note that the coding is 1 for event and 0 for censoring, following the R survival package convention.
a0	A numeric vector of length 1. The reference level of treatment variable that is considered "untreated" or "unexposed".
a1	A numeric vector of length 1.
m_cde	A numeric vector of length 1. Mediator level at which controlled direct effect is evaluated at.
c_cond	A numeric vector of the same length as cvar. Covariate levels at which natural direct and indirect effects are evaluated at.
mreg	A character vector of length 1. Mediator regression type: "linear" or "logistic".
yreg	A character vector of length 1. Outcome regression type: "linear", "logistic", "loglinear", "poisson", "negbin", "survCox", "survAFT_exp", or "survAFT_weibull".
interaction	A logical vector of length 1. The presence of treatment-mediator interaction in the outcome model. Default to TRUE.
casecontrol	A logical vector of length 1. Default to FALSE. Whether data comes from a case-control study.

Value

No return value, called for side effects.

---

validate_regmedint   *Validate soundness of a regmedint object.*

Description

Check the structure of a proposed regmedint object for soundness.

Usage

```
validate_regmedint(x)
```

Arguments

x	A regmedint object.

Value

No return value, called for side effects.

---

vcov.regmedint *Extract variance estimates in the vcov form.*

Description

Extract variance estimates evaluated at a0, a1, m_cde, and c_cond.

Usage

```
## S3 method for class 'regmedint'
vcov(object, a0 = NULL, a1 = NULL, m_cde = NULL, c_cond = NULL, ...)
```

Arguments

object	An object of the [regmedint](#) class.
a0	A numeric vector of length 1
a1	A numeric vector of length 1
m_cde	A numeric vector of length 1 The mediator value at which the controlled direct effect (CDE) conditional on the adjustment covariates is evaluated. If not provided, the default value supplied to the call to [regmedint](#) will be used. Only the CDE is affected.
c_cond	A numeric vector of the same length as cvar. A set of covariate values at which the conditional natural effects are evaluated.
...	For compatibility with the generic. Ignored.

Value

A numeric matrix with the diagonals populated with variance estimates. Off-diagnonals are NA since these are not estimated.

Examples

```
library(regmedint)
data(vv2015)
regmedint_obj <- regmedint(data = vv2015,
                           ## Variables
                           yvar = "y",
                           avar = "x",
                           mvar = "m",
                           cvar = c("c"),
                           eventvar = "event",
                           ## Values at which effects are evaluated
                           a0 = 0,
                           a1 = 1,
                           m_cde = 1,
                           c_cond = 0.5,
                           ## Model types
                           mreg = "logistic",
                           yreg = "survAFT_weibull",
                           ## Additional specification
                           interaction = TRUE,
```

```
                               casecontrol = FALSE)
vcov(regmedint_obj)
## Evaluate at different values
vcov(regmedint_obj, m_cde = 0, c_cond = 1)
```

---

vcov.regmedint_mod_poisson

Robust sandwich variance estimator for modified Poisson

Description

Provide robust sandwich variance-covariance estimate using sandwich.

Usage

```
## S3 method for class 'regmedint_mod_poisson'
vcov(object, ...)
```

Arguments

object	A model object of the class regmedint_mod_poisson
...	For compatibility with the generic.

Value

A variance-covariance matrix using the sandwich.

---

vv2015

Example dataset from Valeri and VanderWeele 2015.

Description

An example dataset from Valeri and VanderWeele (2015) <doi:10.1097/EDE.0000000000000253>.

Usage

vv2015

Format

A tibble with 100 rows and 7 variables:

id Positive integer id.

x Binary treatment assignment variable.

m Binary mediator variable.

y Time to event outcome variable.

cens Binary censoring indicator. Censored is 1.

c Continuous confounder variable.

event Binary event indicator. Event is 1.

Source

https://www.hsph.harvard.edu/tyler-vanderweele/tools-and-tutorials/

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