Package ‘regmedint’

May 11, 2020

Title Regression-Based Causal Mediation Analysis with an Interaction Term

Version 0.1.0

Description ‘R’ re-implementation of the regression-based causal mediation analysis with a treatment-mediator interaction term, as originally implemented in the 'SAS' macro by Valeri and Vander-Weele (2013) <doi:10.1037/a0031034> and Valeri and Vander-Weele (2015) <doi:10.1097/EDE.0000000000000253>. 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, stringr, testthat, tidyverse

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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.

Usage

beta_hat(mreg, mreg_fit, avar, cvar)
calc_myreg

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 should usually be some confounder(s) to account for the common cause structure (confounding) between avar and yvar.

Value

A named numeric vector of coefficients.

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, 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 should usually be some confounder(s) to account for the common cause structure (confounding) between avar and yvar.
- **interaction**: A logical vector of length 1. Default to TRUE. Whether to include a mediator-treatment interaction term in the outcome regression model.

Value

A list containing two functions. The first is for calculating point estimates. The second is for calculating the corresponding
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 deconstruct model objects and feed parameter estimates 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, 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", "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 should usually be some confounder(s) to account for the common cause structure (confounding) between avar and yvar.
interaction A logical vector of length 1. Default to TRUE. Whether to include a mediator-treatment interaction term in the outcome regression model.

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

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

Usage

```r
calc_myreg_mreg_linear_yreg_logistic(
  mreg,
  mreg_fit,
  yreg,
  yreg_fit,
  avar,
  mvar,
  cvar,
  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 should usually be some confounder(s) to account for the common cause structure (confounding) between avar and yvar.
- **interaction**: A logical vector of length 1. Default to TRUE. Whether to include a mediator-treatment interaction term in the outcome regression model.

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 deconstruct model objects and feed 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,  # A character vector of length 1. Mediator regression type: “linear” or “logistic”.
  mreg_fit,  # Model fit from fit_mreg
  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 should usually be some confounder(s) to account for the common cause structure (confounding) between avar and yvar.
  interaction  # A logical vector of length 1. Default to TRUE. Whether to include a mediator-treatment interaction term in the outcome regression model.
)

Arguments

<table>
<thead>
<tr>
<th>Argument</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>mreg</td>
<td>A character vector of length 1. Mediator regression type: “linear” or “logistic”.</td>
</tr>
<tr>
<td>mreg_fit</td>
<td>Model fit from fit_mreg</td>
</tr>
<tr>
<td>yreg_fit</td>
<td>Model fit from fit_yreg</td>
</tr>
<tr>
<td>avar</td>
<td>A character vector of length 1. Treatment variable name.</td>
</tr>
<tr>
<td>mvar</td>
<td>A character vector of length 1. Mediator variable name.</td>
</tr>
<tr>
<td>cvar</td>
<td>A character vector of length &gt; 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 should usually be some confounder(s) to account for the common cause structure (confounding) between avar and yvar.</td>
</tr>
<tr>
<td>interaction</td>
<td>A logical vector of length 1. Default to TRUE. Whether to include a mediator-treatment interaction term in the outcome regression model.</td>
</tr>
</tbody>
</table>

Value

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

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

Usage

```r
calc_myreg_mreg_logistic_yreg_logistic(
  mreg,
  mreg_fit,
  yreg,
  yreg_fit,
  avar,
  mvar,
  cvar,
  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 should usually be some confounder(s) to account for the common cause structure (confounding) between avar and yvar.
- `interaction` A logical vector of length 1. Default to TRUE. Whether to include a mediator-treatment interaction term in the outcome regression model.

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 one.
- **a1**: A numeric vector of length one.
- **m_cde**: A numeric vector of length one. A 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 as long as the number of adjustment covariates. 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",
  ...)
coef.summary_regmedint

\[
\text{coef(summary_regmedint)}
\]

\[
\text{Extract the result matrix from a summary_regmedint object.}
\]

description

Extract the result matrix from a summary_regmedint object.

usage

\[
\text{## S3 method for class 'summary_regmedint'}
\]

\[
\text{coef(object, \ldots)}
\]

arguments

<table>
<thead>
<tr>
<th>argument</th>
<th>description</th>
</tr>
</thead>
<tbody>
<tr>
<td>object</td>
<td>An object with a class of summary_regmedint.</td>
</tr>
<tr>
<td>\ldots</td>
<td>For compatibility with the generic.</td>
</tr>
</tbody>
</table>

value

A matrix populated with results.

examples

\[
\text{library(regmedint)}
\]

\[
\text{data(vv2015)}
\]

\[
\text{regmedint_obj <- regmedint(data = vv2015,}
\]

\[
\text{## Variables}
\]

\[
\text{yvar = "y",}
\]

\[
\text{avar = "x",}
\]

\[
\text{mvar = "m",}
\]

\[
\text{cvar = c("c"),}
\]

\[
\text{eventvar = "event",}
\]

\[
\text{## Values at which effects are evaluated}
\]

\[
\text{a0 = 0,}
\]

\[
\text{a1 = 1,}
\]

\[
\text{m_cde = 1,}
\]

\[
\text{c_cond = 0.5,}
\]

\[
\text{## Model types}
\]

\[
\text{mreg = "logistic",}
\]

\[
\text{coef(regmedint_obj)}
\]

\[
\text{## Evaluate at different values}
\]

\[
\text{coef(regmedint_obj, m_cde = 0, c_cond = 1)}
\]
confint.regmedint

Confidence intervals for mediation parameter 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 one.
a1 A numeric vector of length one.
m_cde A numeric vector of length one. A 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 as long as the number of adjustment covariates. 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

```r
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)
```

Description

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

Usage

```r
fit_mreg(mreg, data, avar, mvar, cvar)
```

Arguments

- **mreg** A character vector of length 1. Mediator regression type: "linear" or "logistic".
- **data** Data frame containing the 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 should usually be some confounder(s) to account for the common cause structure (confounding) between avar and yvar.
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, eventvar, interaction)
```

Arguments

- `data`: Data frame containing the relevant variables.
- `yvar`: A character vector of length 1. Outcome variable name. It should be the time variable for survival outcomes.
- `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 should usually be some confounder(s) to account for the common cause structure (confounding) between `avar` 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.
- `interaction`: A logical vector of length 1. Default to TRUE. Whether to include a mediator-treatment interaction term in the outcome regression model.

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`
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 Pure natural direct effect.

 tnie Total natural indirect effect.

Value

Proportion mediated value.

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 validating the arguments.

Usage

new_regmedint(
  data, yvar, avar, mvar, cvar, eventvar, a0, a1, m_cde, c_cond,
\begin{verbatim}
yreg, mreg, interaction, casecontrol)
\end{verbatim}

**Arguments**

- **data**: Data frame containing the relevant variables.
- **yvar**: A character vector of length 1. Outcome variable name. It should be the time variable for survival outcomes.
- **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 should usually be some confounder(s) to account for the common cause structure (confounding) between avar 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.
- **a0**: A numeric vector of length 1. 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 vector at which conditional 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. Default to TRUE. Whether to include a mediator-treatment interaction term in the outcome regression model.
- **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 one.

a1 A numeric vector of length one.

m_cde A numeric vector of length one. A 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 as long as the number of adjustment covariates. 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**

```r
## 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

```r
library(regmedint)
data(vv2015)
regmedint_obj <- regmedint(data = vv2015,
  yvar = "y",
  avar = "x",
  mvar = "m",
  cvar = c("c"),
  eventvar = "event",
  a0 = 0,
  a1 = 1,
  m_cde = 1,
  c_cond = 0.5,
  mreg = "logistic",
  yreg = "survAFT_weibull",
  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

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

Arguments

<table>
<thead>
<tr>
<th>Argument</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>pnde</td>
<td>Pure natural direct effect.</td>
</tr>
<tr>
<td>tnie</td>
<td>Total natural indirect effect.</td>
</tr>
</tbody>
</table>

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**

```r
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**

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

**Description**

The package is a simple R implementation of the SAS macro as described in Valeri & VanderWeele 2013 and Valeri & VanderWeele 2015 [https://www.hsph.harvard.edu/tyler-vanderweele/tools-and-tutorials/](https://www.hsph.harvard.edu/tyler-vanderweele/tools-and-tutorials/).

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

**Usage**

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

Arguments

data  Data frame containing the relevant variables.
yvar  A character vector of length 1. Outcome variable name. It should be the time variable for survival outcomes.
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 should usually be some confounder(s) to account for the common cause structure (confounding) between avar 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.
a0  A numeric vector of length 1. 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 vector at which conditional 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. Default to TRUE. Whether to include a mediator-treatment interaction term in the outcome regression model.
casecontrol  A logical vector of length 1. Default to FALSE. Whether data comes from a case-control study.

Value

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

Fitting models

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

Several methods are available to examine the regmedint object. print summary coef confint FIXME: Document once implemented.

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)

summary(regmedint_obj)

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,
Arguments

object An object of the \texttt{regmedint} class.
a0 A numeric vector of length one.
a1 A numeric vector of length one.
m_cde A numeric vector of length one. A 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 \texttt{regmedint} will be used. Only the CDE is affected.
c_cond A numeric vector as long as the number of adjustment covariates. 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 \texttt{mreg_fit} object.
args_yreg_fit A named list of argument to be passed to the method for the \texttt{yreg_fit} object.
exponentiate Whether to add exponentiated point and confidence limit estimates. When \texttt{yreg = "linear"}, it is ignored.
level Confidence level for the confidence intervals.
... For compatibility with the generic. Ignored.

Value

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

Examples

library(regmedint)
data(vv2015)
regmedint_obj <- regmedint(data = vv2015,
                          ## Variables
yvar = "y",
a1var = "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,
theta_hat

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

Description

This function extracts coef from yreg_fit and pads 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.

theta_hat

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

Description

This function extracts coef from yreg_fit and pads 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.

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Description

This function extracts coef from yreg_fit and pads 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.

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theta_hat

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

Description

This function extracts coef from yreg_fit and pads 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.
validate_args

Usage

theta_hat(yreg, yreg_fit, avar, mvar, cvar, interaction)

Arguments

<table>
<thead>
<tr>
<th>Argument</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>yreg</td>
<td>A character vector of length 1. Outcome regression type: &quot;linear&quot;, &quot;logistic&quot;, &quot;loglinear&quot;, &quot;poisson&quot;, &quot;negbin&quot;, &quot;survCox&quot;, &quot;survAFT_exp&quot;, or &quot;survAFT_weibull&quot;.</td>
</tr>
<tr>
<td>yreg_fit</td>
<td>Model fit object for yreg (outcome model).</td>
</tr>
<tr>
<td>avar</td>
<td>A character vector of length 1. Treatment variable name.</td>
</tr>
<tr>
<td>mvar</td>
<td>A character vector of length 1. Mediator variable name.</td>
</tr>
<tr>
<td>cvar</td>
<td>A character vector of length &gt; 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 should usually be some confounder(s) to account for the common cause structure (confounding) between avar and yvar.</td>
</tr>
<tr>
<td>interaction</td>
<td>A logical vector of length 1. Default to TRUE. Whether to include a mediator-treatment interaction term in the outcome regression model.</td>
</tr>
</tbody>
</table>

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,
  eventvar,
  a0,
  a1,
  m_cde,
  c_cond,
  mreg,
  yreg,
  interaction,
  casecontrol
)
validate_regmedint

Arguments

data  Data frame containing the relevant variables.
yvar  A character vector of length 1. Outcome variable name. It should be the time variable for survival outcomes.
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 should usually be some confounder(s) to account for the common cause structure (confounding) between avar and yvar.
etventvar  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. 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 vector at which conditional 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. Default to TRUE. Whether to include a mediator-treatment interaction term in the outcome regression model.
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)
vcov.regmedint

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 $a_0$, $a_1$, $m_{cde}$, 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 one.
a1  A numeric vector of length one.
m_cde  A numeric vector of length one. A 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 as long as the number of adjustment covariates. 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-diagonals are NA since these are not estimated.

Examples

library(regmedint)
data(vv2015)
regmedint_obj <- regmedint(data = vv2015,
  ## Variables
  yvar = "y",
avar = "x",
mvar = "m",
...
vcov(regmedint_obj)
## Evaluate at different values
vcov(regmedint_obj, m_cde = 0, c_cond = 1)

describe_vcovregmedint_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


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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