Package ‘iMediate’

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Description

iMediate is a collection of methods developed by our group for mediation analysis. It contains methods built upon likelihoods. Use ?iMediate to see an introduction.

Details

Package: iMediate
Type: Package
Version: 0.4
Date: 2017-09-02
License: GPL (>=2)
LazyLoad: yes

Author(s)

Kai Wang <kai-wang@uiowa.edu>

References


Examples

```r
data("jobs", package = "mediation")

fit.M <- lm(job_seek ~ treat + econ_hard + sex + age, data=jobs)
fit.Y <- lm(depress2 ~ treat + job_seek + econ_hard + sex + age, data=jobs)
mdn(fit.M, fit.Y, "treat")
```
Estimates in Linear M-model and Linear Y-model with Delta Method

Description

Parameter estimates in system of correlated linear M-model and linear Y-model with treatment-mediator interaction using delta method.

Usage

delta.lnl(fit.M, fit.Y, rho = 0)

Arguments

- **fit.M**: a fitted model object for mediator. It must be an object generated by function “lm”
- **fit.Y**: a fitted model object for outcome. It must be an object generated by function “lm”. It can contain treatment-mediator interaction
- **rho**: a numerical variable specifying the correlation coefficient between the residual of the M-model and the residual of the Y-model. Its range is between -1 and 1

Details

P-values are computed from normal distribution.

Value

A list containing the following components:

- **M.model**: a data frame containing the results for the M-model
- **Y.model**: a data frame containing the results for the Y-model

Author(s)

Kai Wang <kai-wang@uiowa.edu>

Examples

```r
# Load data
data("jobs", package = "mediation")

# Fit models
fit.M <- lm(job_seek ~ treat + econ_hard + sex + age, data=jobs)
fit.Y <- lm(depress2 ~ treat + job_seek + econ_hard + sex + age, data=jobs)
delta.lnl(fit.M, fit.Y, rho=0.2)

# Fit models with interaction
fit.M <- lm(job_seek ~ treat + econ_hard + sex + age, data=jobs)
fit.Y <- lm(depress2 ~ treat*job_seek + econ_hard + sex + age, data=jobs)
```


```r
delta.lnl(fit.M, fit.Y, rho=0.5)
```

---

**Description**

Contour plot of joint probability of mediated effect and total effect in the absence of direct effect and joint probability of mediated effect and direct effect assuming $ab = c'$

**Usage**

```r
figure.joint.prob(prob = "mediated.main", n = 100, sig.level = 0.05, grid.size = 0.01)
```

**Arguments**

- `prob` a character string specifying the probability to be plotted. One of "mediated.main" (default) and "mediated.direct". "mediated.main" requests the probability of the mediated effect and the main effect assuming there is no direct effect ($c' = 0$). "mediated.direct" requests the probability of the mediated effect and the direct effect assuming $ab = c'$
- `n` sample size
- `sig.level` significance level used for the test of the mediated effect
- `grid.size` grid size for $a^2$ and $b^2$

**Details**

Basic three-factor mediation model is assumed. Coefficients are standardized such that the variances of treatment, mediator, and outcome are equal to 1. Note that the y-axis is $a^2$ and the x-axis is $b^2$. The default axes labels from R function `plot_ly` are switched in order to make them correct.

**Value**

A plot generated using package `plotly`

**Author(s)**

Kai Wang <kai-wang@uiowa.edu>

**References**

Examples

```r
figure.joint.prob()  # Figure 4 of Wang (2017)
figure.joint.prob(prob="mediated.direct")  # Figure 5 of Wang (2017)
```

Description

Contour plot of relative power of mediated effect versus total effect in the absence of direct effect and relative power of mediated effect versus direct effect when \( ab = c' \).

Usage

```r
figure.relative.power(comparison = "mediated2main", n = 100,
                       sig.level = 0.05, grid.size = 0.01)
```

Arguments

- `comparison` a character string specifying the relative power to be plotted. One of "mediated2main" (default) and "mediated2direct". "mediated2main" requests the log of power ratio for the mediated effect versus the main effect assuming there is no direct effect \( (c' = 0) \). "mediated2direct" requests the log of power ratio for the mediated effect versus the direct effect assuming \( ab = c' \)
- `n` sample size
- `sig.level` significance level used for the test of the mediated effect
- `grid.size` grid size for \( a^2 \) and \( b^2 \)

Details

Basic three-factor mediation model is assumed. Coefficients are standardized such that the variances of treatment, mediator, and outcome are equal to 1. Note that the y-axis is \( a^2 \) and the x-axis is \( b^2 \). The default axes labels from R function `plot_ly` are switched in order to make them correct.

Value

A plot generated using package `plotly`

Author(s)

Kai Wang <kai-wang@uiowa.edu>
References


Examples

```r
figure.relative.power() # Figure 2 of Wang (2017)
figure.relative.power(comparison="mediated2direct") # Figure 3 of Wang (2017)
```

---

**fimle.lnl**

*Full Information Maximum Likelihood Estimates in Linear M-model and Linear Y-model*

---

**Description**

Parameter estimates in system of correlated linear M-model and linear Y-model with treatment-mediator interaction using the full information maximum likelihood method.

**Usage**

```r
fimle.lnl(fit.M, fit.Y, X, rho = 0)
```

**Arguments**

- `fit.M` a fitted model object for mediator. It must be an object generated by function “lm”
- `fit.Y` a fitted model object for outcome. It must be an object generated by function “lm”. It can contain treatment-mediator interaction
- `X` a character string of the name of the treatment variable
- `rho` a numerical variable specifying the correlation coefficient between the residual of the M-model and the residual of the Y-model. Its range is between -1 and 1

**Details**

P-values are computed from normal distribution.

**Value**

A list containing the following components:

- `M.model` a data frame containing the results for the M-model
- `Y.model` a data frame containing the results for the Y-model

**Author(s)**

Kai Wang <kai-wang@uiowa.edu>
References


Examples

data("jobs", package = "mediation")
fit.M <- lm(job_seek ~ treat + econ_hard + sex + age, data=jobs)
fit.Y <- lm(depress ~ treat + job_seek + econ_hard + sex + age, data=jobs)
fit.M <- lm(job_seek ~ treat + econ_hard + sex + age, data=jobs)
fit.Y <- lm(depress ~ treat*job_seek + econ_hard + sex + age, data=jobs)
fimle.lnl(fit.M, fit.Y, "treat", rho=0.2)

Description

mdn conducts mediation analysis in terms of likelihood.

Usage

mdn(fit.M, fit.Y, X, test = "LR", sig.level = 0.05, B = 100)

Arguments

fit.M a fitted model object for mediator. It is an object from which the function logLik can extract the log-likelihood. Examples include those from “lm”, “glm”, etc.
fit.Y a fitted model object for outcome. It can be of a class different from the model for the mediator
X a character string of the name of the treatment variable.
test a character string specifying the test statistic used for the mediated effect. It can be either “S” for the S test proposed in Berger (1996) or “LR” for the LR test discussed in Wang (2017).
sig.level a numerical variable specifying the significance level for the test of the mediated effect.
B an integer specifying the number of replicates used for the bootstrapping
Details

Necessary log-likelihoods are extracted from the two fitted models. Various effects are then calculated. Significance of the mediated effect is known up to whether it is larger or smaller than sig.level. If it is larger, a 1 is reported; otherwise a 0 is reported. There is no p-value.

Value

A list with class “mdn” containing the following components:

- result: a data frame containing the results of the mediation analysis. The are five variables. They include estimates of various effects and lower and upper bounds of the bootstrap confidence interval at level \((1 - \text{sig.level})\) followed by test statistics and their respective p-values.
- test: a character string specifying the test statistic used for the mediated effect
- sig.level: a numerical variable specifying the significance level for the test of the mediated effect.
- Sample.size: number of subjects in the data
- B: an integer specifying the number of replicates used for the bootstrapping

Author(s)

Kai Wang <kai-wang@uiowa.edu>

References


Examples

data("jobs", package = "mediation")

fit.M <- lm(job_seek ~ treat + econ_hard + sex + age, data=jobs)
fit.Y <- lm(depress2 ~ treat + job_seek + econ_hard + sex + age, data=jobs)
mdn(fit.M, fit.Y, "treat")
print.mdn

Print Method for Class "mdn"

Description

print.mdn is the print utility for the output from function mdn

Usage

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

Arguments

x  
an output from function mdn
...

not used.

Details

The p-value for the mediated effect is displayed as greater or smaller than sig.level. For instance, if it is not significant at level 0.05, then “> 0.05” is displayed.

Author(s)

Kai Wang <kai-wang@uiowa.edu>

Examples

data("jobs", package = "mediation")

fit.M <- lm(job_seek ~ treat + econ_hard + sex + age, data=jobs)
fit.Y <- lm(depress2 ~ treat + job_seek + econ_hard + sex + age, data=jobs)
mdn(fit.M, fit.Y, "treat")

pwr.mdn

Power and Sample Size for Mediation Analysis

Description

pwr.mdn Compute power of tests related to mediation analysis or sample size to achieve desired power.

Usage

pwr.mdn(a, b, c.p, tau1, tau2, n = NULL, power = NULL, alpha = 0.05)
Arguments

- **a** specified value for coefficient \(a\)
- **b** specified value for coefficient \(b\)
- **c.p** specified value for coefficient \(c'\)
- **tau1** specified value of the ratio of residual variance of mediator \(M\) to the variance of the treatment \(X\)
- **tau2** specified value of the ratio of residual variance of outcome \(Y\) to the variance of the treatment \(X\)
- **n** the sample size available. Either "n" or "power" must be provided
- **power** a value specifying the desired power. Either "n" or "power" must be provided
- **alpha** specified significance level

Details

This model is for the basic three-factor model. If coefficients are standardized, then \(\tau_1 = 1 - a^2\) and \(\tau_2 = 1 - (c')^2 - b^2 - 2abc'\).

Value

A \(2 \times 5\) matrix

Author(s)

Kai Wang <kai-wang@uiowa.edu>

References


Examples

```r
n = 100
X = rnorm(n)
s2X = mean((X-mean(X))^2)
a=0.3
b=0.3
c.p = a*b

pwr.mdn(a, b, c.p, 1/s2X, 1/s2X, alpha=0.05, power=0.8)
pwr.mdn(a, b, c.p, 1/s2X, 1/s2X, alpha=0.05, n=200)

## using standardized coefficients
pwr.mdn(a, b, c.p, 1-a^2, 1-c.p^2-b^2-2*a*b*c.p, alpha=0.05, power=0.8)
pwr.mdn(a, b, c.p, 1-a^2, 1-c.p^2-b^2-2*a*b*c.p, alpha=0.05, n=200)
```
**S.test**

*S test of Berger (1996)*

---

**Description**

*S.test* conducts the S test proposed in Berger (1996)

**Usage**

*S.test(u1, u2, alpha)*

**Arguments**

- **u1**: a numerical value between 0 and 1.
- **u2**: a numerical value between 0 and 1.
- **alpha**: a numerical variable specifying the significance level for the test.

**Value**

If (u1, u2) falls in the rejection region of the S test, a 1 is returned; otherwise a 0 is returned.

**Author(s)**

Kai Wang <kai-wang@uiowa.edu>

**References**


**Examples**

*S.test(0.1, 0.4, 0.05)*
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