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interferenceCI-package

Exact confidence intervals in the presence of interference

Description

Computes large sample confidence intervals of Liu and Hudgens (2014), conservative exact confidence intervals of Tchetgen Tchetgen and VanderWeele (2012), and exact confidence intervals of Rigdon and Hudgens (2014) for treatment effects on a binary outcome in two-stage randomized experiments with interference.

Details

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Author(s)

Joseph Rigdon <jrigdon@bios.unc.edu>

References


bd

Function to ensure that probability lies in interval $[0, 1]$

Description

Used by targeted sampling algorithm in exactCI
Usage

bd(x)

Arguments

x  Real number

Value

Function returns 0 if \( x < 0 \), \( x \) if \( 0 \leq x \leq 1 \), and 1 if \( x > 1 \)

Author(s)

Joseph Rigdon <jrigdon@bios.unc.edu>

See Also

exactCI

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**estbound**

Estimates and bounds for treatment effects on a binary outcome in a two-stage randomized experiment with interference

**Description**

Computes the estimators of Hudgens and Halloran (2008) and bounds of Rigdon and Hudgens (2014) for treatment effects on a binary outcome in a two-stage randomized experiment with interference

**Usage**

estbound(g, data, m.a0, m.a1)

**Arguments**

- **g** 1st stage of randomization vector where element \( i = 1, \ldots, k \) is equal to 1 if group \( i \) was randomized to strategy \( \alpha_1 \) and 0 if randomized to strategy \( \alpha_0 \)
- **data** \( 2 \times 2 \times k \) array of \( 2 \times 2 \) table data where row 1 is treatment=yes, row 2 is treatment=no, column 1 is outcome=yes, and column 2 is outcome=no
- **m.a0** \( \alpha_0 \) randomization vector where element \( i = 1, \ldots, k \) is equal to the number of subjects in group \( i \) who would receive treatment if group \( i \) was randomized to strategy \( \alpha_0 \)
- **m.a1** \( \alpha_1 \) randomization vector where element \( i = 1, \ldots, k \) is equal to the number of subjects in group \( i \) who would receive treatment if group \( i \) was randomized to strategy \( \alpha_1 \)
Details

Function will return many values (to be used by other functions in this package), but the only important value here is `tab.eff`

Value

`tab.eff` Labeled table of estimates and bounds

Author(s)

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References


Examples

# Made up example with 10 groups of 10 where half are randomized to a0 and half to a1
# a0 is assign 3 of 10 to treatment and half to a1 is assign 6 of 10 to treatment
# d = c(1, 1, 5, 3, 0, 6, 3, 1, 0, 4, 3, 3, 0, 5, 3, 2, 1, 1, 5, 3, 2, 2, 4, 2, 1, 5, 2, 2, 3, 4, 1, 1, 1, 5, 3, 1, 5, 2, 2)
# data.ex = array(d, c(2, 2, 10))
# assign.ex = c(1, 0, 0, 0, 1, 1, 0, 1, 1, 0)

data.ex = array(c(1,1,5,3,0,6,3,1,0,4,3,3,0,5,3,2,1,1,5,3,2,2,4,2,1,5,2,2,3,4,1,1,1,5,3,1,5,2,2), c(2,2,10))
assign.ex = c(1,0,0,0,1,1,0,1,1,0)

e = estbound(assign.ex, data.ex, rep(3, 10), rep(6, 10))
e$tab.eff

```

exactCI

Exact confidence intervals for treatment effects on a binary outcome in a two-stage randomized experiment with interference

Description

Finds exact confidence intervals for treatment effects on a binary outcome in a two-stage randomized experiment with interference. See Section 4.2 of Rigdon and Hudgens (2014) for details.

Usage

```
Arguments

eff  treatment effect of interest; either “DEa0”, “DEa1”, “IE”, “TE”, or “OE”
g   1st stage of randomization vector where element $i = 1, \ldots, k$ is equal to 1 if group $i$ was randomized to strategy $\alpha_1$ and 0 if randomized to strategy $\alpha_0$
data $2 \times 2 \times k$ array of $2 \times 2$ table data where row 1 is treatment=yes, row 2 is treatment=no, column 1 is outcome=yes, and column 2 is outcome=no
m.a0 $\alpha_0$ randomization vector where element $i = 1, \ldots, k$ is equal to the number of subjects in group $i$ who would receive treatment if group $i$ was randomized to strategy $\alpha_0$
m.a1 $\alpha_1$ randomization vector where element $i = 1, \ldots, k$ is equal to the number of subjects in group $i$ who would receive treatment if group $i$ was randomized to strategy $\alpha_1$
B2 number of sharp nulls to test in the targeted sampling algorithm
C2 number of re-randomizations (experiments) to conduct in computing the null distribution of the estimator
level significance level of hypothesis tests, i.e., method yields a 1-level confidence interval

Details

See Section 4.2 of Rigdon and Hudgens (2014) for detailed description. Please plot the p-values against the effect as a check of targeted sampling algorithm performance.

Value

B1 total number of hypotheses that could be tested
C1 total number of re-randomizations (experiments) that could be performed
frac.NA fraction of hypothesized sharp nulls that are not tested
prob1 final value of targeting parameter $q_{p_0}$ in finding lower confidence limit
prob2 final value of targeting parameter $q_{p_u}$ in finding upper confidence limit
effect vector of sharp null hypotheses
p vector of p-values corresponding to the sharp null hypotheses
lower lower limit to confidence interval
upper upper limit to confidence interval

Author(s)

Joseph Rigdon <jrigdon@bios.unc.edu>

References

Examples

# Made up example with 10 groups of 10 where half are randomized to a0 and half to a1
# a0 is assign 3 of 10 to treatment and half to a1 is assign 6 of 10 to treatment
# d = c(1,1,5,3,0,6,3,1,0,4,3,3,0,5,3,2,1,1,5,3,2,2,4,2,1,5,2,2,2,3,4,1,1,1,5,3,1,5,2,2)
# data.ex = array(d,c(2,2,10))
# assign.ex = c(1,0,0,0,1,1,0,1,1,0)

data.ex = array(c(1,1,5,3,0,6,3,1,0,4,3,3,0,5,3,2,1,1,5,3,2,2,4,2,1,5,2,2,2,3,4,1,1,1,5,3,1,5,2,2), c(2,2,10))
assign.ex = c(1,0,0,0,1,1,0,1,1,0)

# Inference for overall effect
l1 = exactCI('OE', assign.ex, data.ex, rep(3, 10), rep(6, 10), 100, 100, 0.05)

HH

---

Large sample confidence intervals for treatment effects on a binary outcome in a two-stage randomized experiment with interference

---

Description

Computes the large sample confidence intervals of Liu and Hudgens (2014) for treatment effects on a binary outcome in a two-stage randomized experiment with interference

Usage

HH(eff, g, data, m.a0, m.a1, level)

Arguments

eff treatment effect of interest; either “DEa0”, “DEa1”, “IE”, “TE”, or “OE”
g 1st stage of randomization vector where element i = 1, . . . , k is equal to 1 if group i was randomized to strategy α1 and 0 if randomized to strategy α0
data 2 × 2 × k array of 2 × 2 table data where row 1 is treatment=yes, row 2 is treatment=no, column 1 is outcome=yes, and column 2 is outcome=no
m.a0 α0 randomization vector where element i = 1, . . . , k is equal to the number of subjects in group i who would receive treatment if group i was randomized to strategy α0
m.a1 α1 randomization vector where element i = 1, . . . , k is equal to the number of subjects in group i who would receive treatment if group i was randomized to strategy α1
level significance level, i.e., method yields a 1-level confidence interval
lsolve

Value

- `est` estimated treatment effect
- `v` estimated variance
- `lower.w` lower limit to Wald confidence interval
- `upper.w` upper limit to Wald confidence interval
- `lower.ch` lower limit to Chebyshev confidence interval
- `upper.ch` upper limit to Chebyshev confidence interval

Author(s)

Joseph Rigdon <jrigdon@bios.unc.edu>

References


Examples

# Table 3 from Hudgens and Halloran (2008)
hh = array(c(16,18,12541-16,12541-18,26,54,11513-26,11513-54,17,119,10772-17, 25134-119,22,122,8883-22,20727-122,15,92,5627-15,13130-92),c(2,2,5))
e1 = HH('OE', c(1,1,0,0,0), hh, round(0.3*c(25082,23026,35906,29610,18757),0), round(0.5*c(25082,23026,35906,29610,18757),0), 0.05)
round(1000*e1$est,3)
round(1000000*e1$v,3)

| lsolve | *Local linear interpolation function*
|--------|--------------------------------------------------|

Description

Computes intersection of a line drawn from \((x_1, y_1)\) to \((x_2, y_2)\) and a horizontal line at level

Usage

\[
\text{lsolve}(x_1, y_1, x_2, y_2, \text{level})
\]

Arguments

- `x1` x-coordinate for first point
- `y1` y-coordinate for first point
- `x2` x-coordinate for second point
- `y2` y-coordinate for second point
- `level` y-coordinate for horizontal line
Value

Returns x-coordinate of intersection point

Author(s)

Joseph Rigdon <jrigdon@bios.unc.edu>

See Also

exactCI

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nchoosem

*Compute randomization matrix*

Description

Returns the \( \binom{n}{m} \) row randomization matrix; uses combinations function in *gtools*

Usage

nchoosem(n, m)

Arguments

- \( n \) total number of subjects
- \( m \) number assigned to treatment in experiment

Value

matrix with \( \binom{n}{m} \) rows of randomizations

Author(s)

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pval

Computes permutation test p-value

Description

Returns permutation test p-value; used in the construction of exact confidence intervals by the function exactCI

Usage

pval(eff, est, null, y0.a0, y1.a0, y0.a1, y1.a1, h, n, m.a0, m.a1, C2)

Arguments

- eff: treatment effect of interest; either “DEa0”, “DEa1”, “IE”, “TE”, or “OE”
- est: estimated treatment effect using estimators from Hudgens and Halloran (2008)
- null: value of treatment effect of interest under the sharp null hypothesis
- y0.a0: hypothesized vector \( \vec{y}(0; \alpha_0) \) under the sharp null hypothesis
- y1.a0: hypothesized vector \( \vec{y}(1; \alpha_0) \) under the sharp null hypothesis
- y0.a1: hypothesized vector \( \vec{y}(0; \alpha_1) \) under the sharp null hypothesis
- y1.a1: hypothesized vector \( \vec{y}(1; \alpha_1) \) under the sharp null hypothesis
- h: the number of groups out of \( k \) total to be randomized to strategy \( \alpha_1 \)
- n: group size vector where element \( i = 1, \ldots, k \) is equal to the number of subjects in group \( i \)
- m.a0: \( \alpha_0 \) randomization vector where element \( i = 1, \ldots, k \) is equal to the number of subjects in group \( i \) who would receive treatment if group \( i \) was randomized to strategy \( \alpha_0 \)
- m.a1: \( \alpha_1 \) randomization vector where element \( i = 1, \ldots, k \) is equal to the number of subjects in group \( i \) who would receive treatment if group \( i \) was randomized to strategy \( \alpha_1 \)
- C2: number of re-randomizations (experiments) to conduct in computing the null distribution of the estimator

Details

See equation (6) in Rigdon and Hudgens (2014)

Author(s)

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References


See Also

exactCI

Description

Returns vector of length n with exactly m 1s and n – m 0s

Usage

rand(n, m)

Arguments

n total number of subjects
m number assigned to treatment in experiment

Value

vector of length n with exactly m 1s and n – m 0s

Author(s)

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Targeted sampling of sharp null hypotheses

Description
Fills in missingness in \( \vec{y}(z; \alpha_s) \) for \( z, s = 0, 1 \) based on targeted sampling algorithm described in Section 4.2 of Rigdon and Hudgens (2014)

Usage
\( \text{sample.n}(\text{eff, y0.a0, y1.a0, y0.a1, y1.a1, p00, p10, p01, p11, n, m.a0, m.a1}) \)

Arguments
- \( \text{eff} \): treatment effect of interest; either “DEa0”, “DEa1”, “IE”, “TE”, or “OE”
- \( \text{y0.a0} \): Observed \( \vec{y}(0; \alpha_0) \); includes NAs where missing
- \( \text{y1.a0} \): Observed \( \vec{y}(1; \alpha_0) \); includes NAs where missing
- \( \text{y0.a1} \): Observed \( \vec{y}(0; \alpha_1) \); includes NAs where missing
- \( \text{y1.a1} \): Observed \( \vec{y}(1; \alpha_1) \); includes NAs where missing
- \( \text{p00} \): Missingness in \( \vec{y}(0; \alpha_0) \) is filled in by sampling from a Bernoulli distribution with mean \( p_{00} \)
- \( \text{p10} \): Missingness in \( \vec{y}(1; \alpha_0) \) is filled in by sampling from a Bernoulli distribution with mean \( p_{10} \)
- \( \text{p01} \): Missingness in \( \vec{y}(0; \alpha_1) \) is filled in by sampling from a Bernoulli distribution with mean \( p_{01} \)
- \( \text{p11} \): Missingness in \( \vec{y}(1; \alpha_0) \) is filled in by sampling from a Bernoulli distribution with mean \( p_{11} \)
- \( \text{n} \): group size vector where element \( i = 1, \ldots, k \) is equal to the number of subjects in group \( i \)
- \( \text{m.a0} \): \( \alpha_0 \) randomization vector where element \( i = 1, \ldots, k \) is equal to the number of subjects in group \( i \) who would receive treatment if group \( i \) was randomized to strategy \( \alpha_0 \)
- \( \text{m.a1} \): \( \alpha_1 \) randomization vector where element \( i = 1, \ldots, k \) is equal to the number of subjects in group \( i \) who would receive treatment if group \( i \) was randomized to strategy \( \alpha_1 \)

Value
- \( \text{y0.a0} \): value of \( \vec{y}(0; \alpha_0) \) after missingness has been filled in using targeted sampling
- \( \text{y1.a0} \): value of \( \vec{y}(1; \alpha_0) \) after missingness has been filled in using targeted sampling
- \( \text{y0.a1} \): value of \( \vec{y}(0; \alpha_1) \) after missingness has been filled in using targeted sampling
- \( \text{y1.a1} \): value of \( \vec{y}(1; \alpha_1) \) after missingness has been filled in using targeted sampling
- \( \text{effect} \): value of treatment effect of interested under sharp null after missingness filled in using targeted sampling
Author(s)
Joseph Rigdon <jrigdon@bios.unc.edu>

References

See Also
exactCI

tv
Conservative exact confidence intervals for treatment effects on a binary outcome in a two-stage randomized experiment with interference

Description
Computes the conservative exact confidence intervals of Tchetgen Tchetgen and VanderWeele (2012) for treatment effects on a binary outcome in a two-stage randomized experiment with interference

Usage
TV(ef, g, data, m.a0, m.a1, level)

Arguments
\( \text{eff} \)  
 treatment effect of interest; either “DEa0”, “DEa1”, “IE”, “TE”, or “OE”

\( \text{g} \)  
1st stage of randomization vector where element \( i = 1, \ldots, k \) is equal to 1 if group \( i \) was randomized to strategy \( \alpha_1 \) and 0 if randomized to strategy \( \alpha_0 \)

\( \text{data} \)  
\( 2 \times 2 \times k \) array of \( 2 \times 2 \) table data where row 1 is treatment=yes, row 2 is treatment=no, column 1 is outcome=yes, and column 2 is outcome=no

\( \text{m.a0} \)  
\( \alpha_0 \) randomization vector where element \( i = 1, \ldots, k \) is equal to the number of subjects in group \( i \) who would receive treatment if group \( i \) was randomized to strategy \( \alpha_0 \)

\( \text{m.a1} \)  
\( \alpha_1 \) randomization vector where element \( i = 1, \ldots, k \) is equal to the number of subjects in group \( i \) who would receive treatment if group \( i \) was randomized to strategy \( \alpha_1 \)

\( \text{level} \)  
significance level, i.e., method yields a \( 1 \)-level confidence interval

Details
Confidence intervals are based on a Hoeffding-type exponential inequality; see section 4.3.2 of Tchetgen Tchetgen and VanderWeele (2012)
Value

est  estimated treatment effect from Hudgens and Halloran (2008)
v    half-width of confidence interval
lower lower limit of confidence interval
upper upper limit of confidence interval

Author(s)

Joseph Rigdon <jrigdon@bios.unc.edu>

References


Examples

# Made up example with 10 groups of 10 where half are randomized to a0 and half to a1
# a0 is assign 3 of 10 to treatment and half to a1 is assign 6 of 10 to treatment
# d = c(1,1,5,3,0,6,3,1,0,4,3,3,0,5,3,2,1,1,5,3,2,2,4,2,1,5,2,2,2,3,4,1,1,1,5,3,1,5,2,2)
# data.ex = array(d,c(2,2,10))
# assign.ex = c(1,0,0,0,1,0,1,1,0,1,0)

# Inference for overall effect
TV('OE',assign.ex,data.ex,rep(3,10),rep(6,10),0.05)
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