Package 'TrendInTrend'

March 5, 2020

Type Package

Title Odds Ratio Estimation and Power Calculation for the Trend in Trend Model

Version 1.1.3

Date 2020-02-24

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Description Estimation of causal odds ratio and power calculation given trends in exposure prevalence and outcome frequencies of stratified data.

Depends R (>= 3.2.2), stats

Imports pROC, rms, nleqslv, pracma

Encoding UTF-8

License GPL (>= 2)

RoxygenNote 6.1.1

NeedsCompilation no

Repository CRAN

Date/Publication 2020-03-05 17:30:02 UTC

R topics documented:

GenData *Generate simulation data*

Description

Generate simulation data

Usage

```
GenData()
```

Details

Besides n11, n10, n01, n00, this function also returns some other simulation paramters, including C1, C2, C3, h2. See Ji et al. (2017) for more details.

Value

n11	A G by Tn matrix with n11[i,j] being the count of treated subjests with an event within group i at time j. The number of strata is G=5 and the number of time intervals is Tn=20.
n10	A G by Tn matrix with n10[i,j] being the count of treated subjests without an event within group i at time j.
n01	A G by Tn matrix with n01[i,j] being the count of untreated subjests with an event within group i at time j.
n00	A G by Tn matrix with n00[i,j] being the count of untreated subjests without an event within group i at time j.

References

Ji X, Small DS, Leonard CE, Hennessy S (2017). The Trend-in-trend Research Design for Causal Inference. Epidemiology. 28(4), 529–536.

OR *An Odds Ratio Estimation Function*

Description

Estimate causal odds ratio (OR) given trends in exposure prevalence and outcome frequencies of stratified data.

Usage

```
OR(n11, n10, n01, n00, bnull = c(-10, 0, 0), n_explore = 10,
  noise_var = c(1, 1, 0.5), n_boot = 50, alpha = 0.05)
```

Arguments

n11	A G by Tn matrix with n11[i,j] being the count of treated subjects with an event within group i at time j. The number of strata is G and the number of time intervals is Tn.
n10	A G by Tn matrix with n10[i,j] being the count of treated subjects without an event within group i at time j.
n01	A G by Tn matrix with n01[i,j] being the count of untreated subjects with an event within group i at time j.
n00	A G by Tn matrix with n00[i,j] being the count of untreated subjects without an event within group i at time j.
bnull	Initial values for beta0, beta1, beta2 for the optimization algorithm. Default is (-10,0,0). It is suggested the initial value of beta0 be set as a small negative number (-4 or smaller) for the rare outcome model to be computationally stable.
n_explore	Number of iterations in the optimization algorithm to stabilize the outputs. Default is 10.
noise_var	The optimization algorithm is iterated n_explore times. Results from the previous iteration with added Gaussian noise are set as the starting values for the new iteration. Bigger noise_var indicates larger variance for the Gaussian noise, meaning more exploration during the iterations. Default is (1,1,0.5).
n_boot	Number of bootstrap iterations to construct the confidence interval for the estimated odds ratio beta1. Default is 50.
alpha	(1-alpha) is the significance level of the confidence interval. Default is 0.05.

Details

This function estimates the odds ratio parameter beta1 in the subject-specific model in Ji et al. (2017)

$$logit(E[Y(it)|Z(it), G(i), X(it)]) = beta0 + Z(it) * beta1 + t * beta2 + X(it)\gamma$$

where $Z(it)$ and $Y(it)$ are the binary exposure and outcome variables for individual i at time t. There are three caveats regarding the implementation. First, the trend-in-trend design works better when there are substantial exposure trend differences across strata. If the exposure trend is roughly parallel across strata, the method may fail to converge. Second, we recommend running the OR function for multiple starting points to evaluate the stability of the optimization algorithm. Third, the bootstrap confidence interval may have slightly lower coverage probability than the nominal significance level 1-alpha.

Value

beta	Maximum likelihood estimators (MLE) for beta0, beta1, beta2. Beta1 is the estimated treatment-event odds ratio. Because we conduct n_explore iterations, the set of parameters that is associated with the highest log likelihood is the output.
CI_beta1	1-alpha confidence interval for beta1.
ll	Log likelihood evaluated at the MLE.

not_identified	Equals 1 if the MLE is not identifiable or weakly identified. This could happen when there are multiple sets of parameters associated with the highest log likelihood, or the bootstrap confidence interval fails to cover the estimated beta1.

References

Ji X, Small DS, Leonard CE, Hennessy S (2017). The Trend-in-trend Research Design for Causal Inference. Epidemiology 28(4), 529–536.
Ertefaie, A., Small, D., Ji, X., Leonard, C., Hennessy, S. (2018). Statistical Power for Trend-in-trend Design. Epidemiology 29(3), e21.
Ertefaie, A., Small, D., Leonard, C., Ji, X., Hennessy, S. (2018). Assumptions Underlying the Trend-in-Trend Research Design. Epidemiology 29(6), e52-e53.

Examples

```
data <- GenData()
n11 <- data[[1]]
n10 <- data[[2]]
n01 <- data[[3]]
n00 <- data[[4]]
results <- OR(n11,n10,n01,n00)
```

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ttdetect *Finding a detectable odds Ratio with a given power*

Description

Monte Carlo power calculation for a trend-in-trend design.

Usage

```
ttdetect(N, time, G, cstat, alpha_t, beta_0, power, nrep, OR.vec)
```

Arguments

N	Sample Size.
time	Number of time points.
G	Number of CPE strata.
cstat	Value of the c-statistic.
alpha_t	A scaler that qunatifies the trend in exposure prevalence.
beta_0	Intercept of the outcome model.
power	A given power.
nrep	Number of Monte Carlo replicates.
OR.vec	A vector of odds Ratios.

Value

Power	A vector of calculated powers for a given OR.vec
OR.vec	A vector of odds Ratios
DetectDifference	A detectable difference for a given power value

References

Ertefaie, A., Small, D., Ji, X., Leonard, C., Hennessy, S. (2018). Statistical Power for Trend-in-trend Design. Epidemiology 29(3), e21.

Examples

```
set.seed(123)
ttdetect(N=10000,time=10,G=10,cstat=0.75,alpha_t= 0.4,beta_0=-4.3,
        power=0.80,nrep=50, OR.vec=c(1.9,2.0,2.1,2.2))
```

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ttpower *Power calculation in trend-in-trend design*

Description

Monte Carlo power calculation for trend-in-trend design.

Usage

```
ttpower(N, time, G, cstat, alpha_t, beta_0, h1.OR, nrep)
```

Arguments

N	Sample Size.
time	Number of time points.
G	Number of CPE strata.
cstat	Value of the c-statistic.
alpha_t	A scaler that qunatifies the trend in exposure prevalence.
beta_0	Intercept of the outcome model.
h1.OR	A given odds ratio.
nrep	Number of Monte Carlo replicates.

Value

power	Power of detecting the given Odds Ratio.

References

Ertefaie A, Small DS, Ji X, Leonard C, Hennessy S (2018). Statistical Power for Trend-in-trend Design. Epidemiology. 29(3), e21–e23.

Examples

```
set.seed(123)
ttpower(N=10000,time=10,G=10,cstat=0.75,alpha_t= 0.4,beta_0=-4.3,h1.OR=1.5,nrep=50)
```

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