Package ‘TrendInTrend’

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Title Odds Ratio Estimation and Power Calculation for the Trend in Trend Model
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Description Estimation of causal odds ratio and power calculation given trends in exposure prevalence and outcome frequencies of stratified data.
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GenData

Description
Generate simulation data

Usage
GenData()

Details
Besides n11, n10, n01, n00, this function also returns some other simulation parameters, 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 subjects 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 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.

References

OR

Description
An Odds Ratio Estimation Function

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

\( n_{11} \)  
A G by Tn matrix with \( n_{11}[i,j] \) 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 \( Tn \).

\( n_{10} \)  
A G by Tn matrix with \( n_{10}[i,j] \) being the count of treated subjects without an event within group \( i \) at time \( j \).

\( n_{01} \)  
A G by Tn matrix with \( n_{01}[i,j] \) being the count of untreated subjects with an event within group \( i \) at time \( j \).

\( n_{00} \)  
A G by Tn matrix with \( n_{00}[i,j] \) being the count of untreated subjects without an event within group \( i \) at time \( j \).

\( bnull \)  
Initial values for \( \beta_0, \beta_1, \beta_2 \) for the optimization algorithm. Default is \((-10,0,0)\). It is suggested the initial value of \( \beta_0 \) be set as a small negative number (-4 or smaller) for the rare outcome model to be computationally stable.

\( n_{\text{explore}} \)  
Number of iterations in the optimization algorithm to stabilize the outputs. Default is 10.

\( \text{noise}_{-}\text{var} \)  
The optimization algorithm is iterated \( n_{\text{explore}} \) times. Results from the previous iteration with added Gaussian noise are set as the starting values for the new iteration. Bigger \( \text{noise}_{-}\text{var} \) indicates larger variance for the Gaussian noise, meaning more exploration during the iterations. Default is \((1,1,0.5)\).

\( n_{\text{boot}} \)  
Number of bootstrap iterations to construct the confidence interval for the estimated odds ratio \( \beta_1 \). Default is 50.

\( \text{alpha} \)  
\((1-\text{alpha})\) is the significance level of the confidence interval. Default is 0.05.

Details

This function estimates the odds ratio parameter \( \beta_1 \) in the subject-specific model in Ji et al. (2017)

\[
\text{logit}(E[Y(it)|Z(it), G(i), X(it)]) = \beta_0 + Z(it) \times \beta_1 + t \times \beta_2 + X(it)\gamma
\]

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

\( \text{beta} \)  
Maximum likelihood estimators (MLE) for \( \beta_0, \beta_1, \beta_2 \). \( \beta_1 \) is the estimated treatment-event odds ratio. Because we conduct \( n_{\text{explore}} \) iterations, the set of parameters that is associated with the highest log likelihood is the output.

\( \text{CI}_{\beta_1} \)  
1-alpha confidence interval for \( \beta_1 \).

\( \text{ll} \)  
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


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 quantifies 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.
**ttpower**

**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**


**Examples**

```r
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))
```

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

**Description**

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

**Usage**

```r
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 quantifies 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


Examples

```r
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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