# Package 'ORTH.Ord'

**Title** Alternating Logistic Regression with Orthogonalized Residuals
for Correlated Ordinal Outcomes

**Version** 1.0.1

**Description** A modified version of alternating logistic regressions (ALR) with estimation based on orthogonalized residuals (ORTH) is implemented, which use paired estimating equations to jointly estimate parameters in marginal mean and within-association models. The within-cluster association between ordinal responses is modeled by global pairwise odds ratios (POR). A finite-sample bias correction is provided to POR parameter estimates based on matrix multiplicative adjusted orthogonalized residuals (MMORTH) for correcting estimating equations, and different bias-corrected variance estimators such as BC1, BC2, and BC3.

**License** GPL (>= 2)

**Encoding** UTF-8

**RoxygenNote** 7.3.1

**Depends** R (>= 4.0), magic, MASS

**Suggests** knitr, rmarkdown

**VignetteBuilder** knitr

**LazyData** true

**NeedsCompilation** no

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**Repository** CRAN

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ORTH.Ord                          *function: ORTH.Ord*

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**Description**

This function is designed for analyzing correlated ordinal data with ability to correct small-sample bias.

**Usage**

```
ORTH.Ord(
  formula_mean,
  data_mean,
  cluster,
  formula_por = NULL,
  data_por = NULL,
  MMORTH = FALSE,
  BC = NULL,
  init_beta = NULL,
  init_alpha = NULL,
  miter = 30,
  crit_level = 1e-04
)
```

**Arguments**

| | |
|---|---|
| formula_mean | the symbolic description of the marginal mean model that contains the ordinal outcome and marginal mean covariates. |
| data_mean | the data set containing the ordinal outcome and marginal mean covariates. |
| cluster | cluster ID (consecutive integers) in data_mean. |
| formula_por | the symbolic description of marginal association model in the form of a one-sided formula, default is NULL. When leaving formula_por as default, independence working correlation will be used. |
| data_por | a data set for marginal association model, default is NULL. When leaving data_por as default, independence working correlation will be used. |
| MMORTH | a logical value to indicate if matrix-adjusted estimating equations will be applied for the association estimation, default is FALSE. |
| BC | an option to apply bias-correction on covariance estimation, default is NULL. Possible values are "BC1", "BC2", or "BC3". |
| init_beta | pre-specified starting values for parameters in the mean model, default is NULL. |
| init_alpha | pre-specified starting values for parameters in the association model, default is NULL. |
| miter | maximum number of iterations for Fisher scoring, default is 30. |
| crit_level | tolerance for convergence, default is 0.0001. |

## Details

The method is a modified version of alternating logistic regressions with estimation based on orthogonalized residuals (ORTH). The within-cluster association between ordinal responses is modeled by global pairwise odds ratios (POR). A small-sample bias correction to POR parameter estimates based on matrix multiplicative adjusted orthogonalized residuals (MMORTH) for correcting estimating equations, and bias-corrected sandwich estimators with different options for covariance estimation, i.e. BC1 (Kauermann & Zeger (1986)), BC2 (Mancl & DeRouen (2001)), and BC3 (Fay & Graubard (2001)).

## Value

A list is returned. The first element is a matrix for model parameter estimates; the second element is a variance-covariance matrix for model parameters without bias correction (BC0). Additional variance-covarianc matrices will be added if argument BC is specified.

## References

Can Meng, Mary Ryan, Paul Rathouz, Elizabeth Turner, John S Preisser, and Fan Li. 2023. ORTH.Ord: An R package for analyzing correlated ordinal outcomes using alternating logistic regressions with orthogonalized residuals. *Computer Methods and Programs in Biomedicine*, 237, doi:10.1016/j.cmpb.2023.107567.

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| simdata | *A simulated data with correlated ordinal outcome for cluster randomized trial* |
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## Description

A dataset contains 50 clusters, in which 25 clusters are in group 1 and the other 25 clusters are in group 0 Each cluster has 9 observations, each observation has an ordinal outcome Y with three levels (i.e., 0, 1, 2). The outcomes within each cluster are correlated.

## Usage

```
simdata
```

## Format

a data frame with 450 rows and 5 variables:

**Obs** number of observations per cluster

**Y** ordinal outcome with three levels, possible values are 0, 1, and 2

**Cluster** number of clusters

**X1** a cluster-level binary covariate: X1=1 if in group 1 and X1=0 otherwise

**X2** an observation-level continuous covariate: generatd from normal distribution with mean=1 and SD=1

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