Package 'CoxBcv'

May 7, 2026

Type Package

Title Bias-Corrected Sandwich Variance Estimators for Marginal Cox Analysis of Cluster Randomized Trials

Version 0.0.1.0

Maintainer Xueqi Wang <xueqi.wang@duke.edu>

Description The implementation of bias-corrected sandwich variance estimators for the analysis of cluster randomized trials with time-to-event outcomes using the marginal Cox model, proposed by Wang et al. (under review).

License GPL (>= 2)

RoxygenNote 7.1.2

Encoding UTF-8

Imports pracma, survival

NeedsCompilation no

Author Xueqi Wang [aut, cre],
Elizabeth Turner [aut],
Fan Li [aut]

Repository CRAN

Date/Publication 2022-03-09 08:10:02 UTC

Contents

CoxBcv.fg *Fay and Graubard (FG) bias-corrected sandwich variance estimator*

Description

Calculate the Fay and Graubard (FG; 2001) bias-corrected sandwich variance estimator, for marginal Cox analysis of cluster randomized trials, proposed by Wang et al. (under review).

Usage

```
CoxBcv.fg(Y, Delta, X, ID)
```

Arguments

Y	vector of observed time-to-event data.
Delta	vector of censoring indicators.
X	matrix of marginal mean covariates with one column for one covariate (design matrix excluding intercept).
ID	vector of cluster identifiers.

Value

- coef - estimate of coefficients.
- exp(coef) - estimate of hazard ratio.
- FG-var - FG bias-corrected sandwich variance estimate of coef.

References

Fay, M. P., & Graubard, B. I. (2001). Small-sample adjustments for Wald-type tests using sandwich estimators. Biometrics, 57(4), 1198-1206.

Wang, X., Turner, E. L., & Li, F. Improving sandwich variance estimation for marginal Cox analysis of cluster randomized trials. Under Review.

Examples

```
Y <- c(11,19,43,100,7,100,100,62,52,1,7,6)
Delta <- c(1,1,1,0,1,0,0,1,1,1,1,1)
X1 <- c(0,0,0,0,0,0,1,1,1,1,1,1)
X2 <- c(-19,6,-25,48,10,-25,15,22,17,-9,45,12)
ID <- c(1,1,2,2,3,3,4,4,5,5,6,6)

X <- X1
CoxBcv.fg(Y,Delta,X,ID)

X <- cbind(X1,X2)
CoxBcv.fg(Y,Delta,X,ID)
```

CoxBcv.fgmr *Hybrid FGMR bias-corrected sandwich variance estimator*

Description

Calculate the hybrid FGMR bias-corrected sandwich variance estimator, for marginal Cox analysis of cluster randomized trials, proposed by Wang et al. (under review). FG: Fay and Graubard (2001); MR: martingale residual.

Usage

```
CoxBcv.fgmr(Y, Delta, X, ID)
```

Arguments

Y	vector of observed time-to-event data.
Delta	vector of censoring indicators.
X	matrix of marginal mean covariates with one column for one covariate (design matrix excluding intercept).
ID	vector of cluster identifiers.

Value

- coef - estimate of coefficients.
- exp(coef) - estimate of hazard ratio.
- FGMR-var - FGMR bias-corrected sandwich variance estimate of coef.

References

Fay, M. P., & Graubard, B. I. (2001). Small-sample adjustments for Wald-type tests using sandwich estimators. Biometrics, 57(4), 1198-1206.

Wang, X., Turner, E. L., & Li, F. Improving sandwich variance estimation for marginal Cox analysis of cluster randomized trials. Under Review.

Examples

```
Y <- c(11,19,43,100,7,100,100,62,52,1,7,6)
Delta <- c(1,1,1,0,1,0,0,1,1,1,1,1)
X1 <- c(0,0,0,0,0,0,1,1,1,1,1,1)
X2 <- c(-19,6,-25,48,10,-25,15,22,17,-9,45,12)
ID <- c(1,1,2,2,3,3,4,4,5,5,6,6)

X <- X1
CoxBcv.fgmr(Y,Delta,X,ID)

X <- cbind(X1,X2)
CoxBcv.fgmr(Y,Delta,X,ID)
```

CoxBcv.kc *Kauermann and Carroll (KC) bias-corrected sandwich variance estimator*

Description

Calculate the Kauermann and Carroll (KC; 2001) bias-corrected sandwich variance estimator, for marginal Cox analysis of cluster randomized trials, proposed by Wang et al. (under review).

Usage

```
CoxBcv.kc(Y, Delta, X, ID)
```

Arguments

Y	vector of observed time-to-event data.
Delta	vector of censoring indicators.
X	matrix of marginal mean covariates with one column for one covariate (design matrix excluding intercept).
ID	vector of cluster identifiers.

Value

- coef - estimate of coefficients.
- exp(coef) - estimate of hazard ratio.
- KC-var - KC bias-corrected sandwich variance estimate of coef.

References

Kauermann, G., & Carroll, R. J. (2001). A note on the efficiency of sandwich covariance matrix estimation. Journal of the American Statistical Association, 96(456), 1387-1396.

Wang, X., Turner, E. L., & Li, F. Improving sandwich variance estimation for marginal Cox analysis of cluster randomized trials. Under Review.

Examples

```
Y <- c(11,19,43,100,7,100,100,62,52,1,7,6)
Delta <- c(1,1,1,0,1,0,0,1,1,1,1,1)
X1 <- c(0,0,0,0,0,0,1,1,1,1,1,1)
X2 <- c(-19,6,-25,48,10,-25,15,22,17,-9,45,12)
ID <- c(1,1,2,2,3,3,4,4,5,5,6,6)

X <- X1
CoxBcv.kc(Y,Delta,X,ID)

X <- cbind(X1,X2)
CoxBcv.kc(Y,Delta,X,ID)
```

`CoxBcv.kcmr` *Hybrid KCMR bias-corrected sandwich variance estimator*

Description

Calculate the hybrid KCMR bias-corrected sandwich variance estimator, for marginal Cox analysis of cluster randomized trials, proposed by Wang et al. (under review). KC: Kauermann and Carroll (2001); MR: martingale residual.

Usage

```
CoxBcv.kcmr(Y, Delta, X, ID)
```

Arguments

`Y`	vector of observed time-to-event data.
`Delta`	vector of censoring indicators.
`X`	matrix of marginal mean covariates with one column for one covariate (design matrix excluding intercept).
`ID`	vector of cluster identifiers.

Value

- coef - estimate of coefficients.
- exp(coef) - estimate of hazard ratio.
- KCMR-var - KCMR bias-corrected sandwich variance estimate of coef.

References

Kauermann, G., & Carroll, R. J. (2001). A note on the efficiency of sandwich covariance matrix estimation. Journal of the American Statistical Association, 96(456), 1387-1396.

Wang, X., Turner, E. L., & Li, F. Improving sandwich variance estimation for marginal Cox analysis of cluster randomized trials. Under Review.

Examples

```
Y <- c(11,19,43,100,7,100,100,62,52,1,7,6)
Delta <- c(1,1,1,0,1,0,0,1,1,1,1,1)
X1 <- c(0,0,0,0,0,0,1,1,1,1,1,1)
X2 <- c(-19,6,-25,48,10,-25,15,22,17,-9,45,12)
ID <- c(1,1,2,2,3,3,4,4,5,5,6,6)

X <- X1
CoxBcv.kcmr(Y,Delta,X,ID)

X <- cbind(X1,X2)
CoxBcv.kcmr(Y,Delta,X,ID)
```

`CoxBcv.mbn` *Morel, Bokossa, and Neerchal (MBN) bias-corrected sandwich variance estimator*

Description

Calculate the Morel, Bokossa, and Neerchal (MBN; 2003) bias-corrected sandwich variance estimator, for marginal Cox analysis of cluster randomized trials, proposed by Wang et al. (under review).

Usage

```
CoxBcv.mbn(Y, Delta, X, ID)
```

Arguments

`Y`	vector of observed time-to-event data.
`Delta`	vector of censoring indicators.
`X`	matrix of marginal mean covariates with one column for one covariate (design matrix excluding intercept).
`ID`	vector of cluster identifiers.

Value

- coef - estimate of coefficients.
- exp(coef) - estimate of hazard ratio.
- MBN-var - MBN bias-corrected sandwich variance estimate of coef.

References

Morel, J. G., Bokossa, M. C., & Neerchal, N. K. (2003). Small sample correction for the variance of GEE estimators. Biometrical Journal: journal of mathematical methods in biosciences, 45(4), 395-409.

Wang, X., Turner, E. L., & Li, F. Improving sandwich variance estimation for marginal Cox analysis of cluster randomized trials. Under Review.

Examples

```
Y <- c(11,19,43,100,7,100,100,62,52,1,7,6)
Delta <- c(1,1,1,0,1,0,0,1,1,1,1,1)
X1 <- c(0,0,0,0,0,0,1,1,1,1,1,1)
X2 <- c(-19,6,-25,48,10,-25,15,22,17,-9,45,12)
ID <- c(1,1,2,2,3,3,4,4,5,5,6,6)

X <- X1
CoxBcv.mbn(Y,Delta,X,ID)
```

```
X <- cbind(X1,X2)
CoxBcv.mbn(Y,Delta,X,ID)
```

`CoxBcv.mbnmr` *Hybrid MBNMR bias-corrected sandwich variance estimator*

Description

Calculate the hybrid MBNMR bias-corrected sandwich variance estimator for marginal Cox analysis of cluster randomized trials, proposed by Wang et al. (under review). MBN: Morel, Bokossa, and Neerchal (2003); MR: martingale residual.

Usage

```
CoxBcv.mbnmr(Y, Delta, X, ID)
```

Arguments

`Y`	vector of observed time-to-event data.
`Delta`	vector of censoring indicators.
`X`	matrix of marginal mean covariates with one column for one covariate (design matrix excluding intercept).
`ID`	vector of cluster identifiers.

Value

- coef - estimate of coefficients.
- exp(coef) - estimate of hazard ratio.
- MBNMR-var - MBNMR bias-corrected sandwich variance estimate of coef.

References

Morel, J. G., Bokossa, M. C., & Neerchal, N. K. (2003). Small sample correction for the variance of GEE estimators. Biometrical Journal: journal of mathematical methods in biosciences, 45(4), 395-409.

Wang, X., Turner, E. L., & Li, F. Improving sandwich variance estimation for marginal Cox analysis of cluster randomized trials. Under Review.

Examples

```
Y <- c(11,19,43,100,7,100,100,62,52,1,7,6)
Delta <- c(1,1,1,0,1,0,0,1,1,1,1,1)
X1 <- c(0,0,0,0,0,0,1,1,1,1,1,1)
X2 <- c(-19,6,-25,48,10,-25,15,22,17,-9,45,12)
ID <- c(1,1,2,2,3,3,4,4,5,5,6,6)

X <- X1
CoxBcv.mbnmr(Y,Delta,X,ID)

X <- cbind(X1,X2)
CoxBcv.mbnmr(Y,Delta,X,ID)
```

`CoxBcv.md` *Mancl and DeRouen (MD) bias-corrected sandwich variance estimator*

Description

Calculate the Mancl and DeRouen (MD; 2001) bias-corrected sandwich variance estimator, for marginal Cox analysis of cluster randomized trials, proposed by Wang et al. (under review).

Usage

```
CoxBcv.md(Y, Delta, X, ID)
```

Arguments

`Y`	vector of observed time-to-event data.
`Delta`	vector of censoring indicators.
`X`	matrix of marginal mean covariates with one column for one covariate (design matrix excluding intercept).
`ID`	vector of cluster identifiers.

Value

- coef - estimate of coefficients.
- exp(coef) - estimate of hazard ratio.
- MD-var - MD bias-corrected sandwich variance estimate of coef.

References

Mancl, L. A., & DeRouen, T. A. (2001). A covariance estimator for GEE with improved small-sample properties. Biometrics, 57(1), 126-134.

Wang, X., Turner, E. L., & Li, F. Improving sandwich variance estimation for marginal Cox analysis of cluster randomized trials. Under Review.

Examples

```
Y <- c(11,19,43,100,7,100,100,62,52,1,7,6)
Delta <- c(1,1,1,0,1,0,0,1,1,1,1,1)
X1 <- c(0,0,0,0,0,0,1,1,1,1,1,1)
X2 <- c(-19,6,-25,48,10,-25,15,22,17,-9,45,12)
ID <- c(1,1,2,2,3,3,4,4,5,5,6,6)

X <- X1
CoxBcv.md(Y,Delta,X,ID)

X <- cbind(X1,X2)
CoxBcv.md(Y,Delta,X,ID)
```

`CoxBcv.mdmr` *Hybrid MDMR bias-corrected sandwich variance estimator*

Description

Calculate the hybrid MDMR bias-corrected sandwich variance estimator, for marginal Cox analysis of cluster randomized trials, proposed by Wang et al. (under review). MD: Mancl and DeRouen (2001); MR: martingale residual.

Usage

```
CoxBcv.mdmr(Y, Delta, X, ID)
```

Arguments

`Y`	vector of observed time-to-event data.
`Delta`	vector of censoring indicators.
`X`	matrix of marginal mean covariates with one column for one covariate (design matrix excluding intercept).
`ID`	vector of cluster identifiers.

Value

- coef - estimate of coefficients.
- exp(coef) - estimate of hazard ratio.
- MDMR-var - MDMR bias-corrected sandwich variance estimate of coef.

References

Mancl, L. A., & DeRouen, T. A. (2001). A covariance estimator for GEE with improved small-sample properties. Biometrics, 57(1), 126-134.

Wang, X., Turner, E. L., & Li, F. Improving sandwich variance estimation for marginal Cox analysis of cluster randomized trials. Under Review.

Examples

```
Y <- c(11,19,43,100,7,100,100,62,52,1,7,6)
Delta <- c(1,1,1,0,1,0,0,1,1,1,1,1)
X1 <- c(0,0,0,0,0,0,1,1,1,1,1,1)
X2 <- c(-19,6,-25,48,10,-25,15,22,17,-9,45,12)
ID <- c(1,1,2,2,3,3,4,4,5,5,6,6)

X <- X1
CoxBcv.mdmr(Y,Delta,X,ID)

X <- cbind(X1,X2)
CoxBcv.mdmr(Y,Delta,X,ID)
```

`CoxBcv.mr` *Martingale residual (MR) bias-corrected sandwich variance estimator*

Description

Calculate the martingale residual (MR) bias-corrected sandwich variance estimator, for marginal Cox analysis of cluster randomized trials, proposed by Wang et al. (under review).

Usage

```
CoxBcv.mr(Y, Delta, X, ID)
```

Arguments

`Y`	vector of observed time-to-event data.
`Delta`	vector of censoring indicators.
`X`	matrix of marginal mean covariates with one column for one covariate (design matrix excluding intercept).
`ID`	vector of cluster identifiers.

Value

- coef - estimate of coefficients.
- exp(coef) - estimate of hazard ratio.
- MR-var - MR bias-corrected sandwich variance estimate of coef.

References

Wang, X., Turner, E. L., & Li, F. Improving sandwich variance estimation for marginal Cox analysis of cluster randomized trials. Under Review.

Examples

```
Y <- c(11,19,43,100,7,100,100,62,52,1,7,6)
Delta <- c(1,1,1,0,1,0,0,1,1,1,1,1)
X1 <- c(0,0,0,0,0,0,1,1,1,1,1,1)
X2 <- c(-19,6,-25,48,10,-25,15,22,17,-9,45,12)
ID <- c(1,1,2,2,3,3,4,4,5,5,6,6)

X <- X1
CoxBcv.mr(Y,Delta,X,ID)

X <- cbind(X1,X2)
CoxBcv.mr(Y,Delta,X,ID)
```

`CoxBcv.rob` *Uncorrected robust sandwich variance estimator*

Description

Calculate the uncorrected robust sandwich variance estimator for marginal Cox analysis of cluster randomized trials (Spiekerman and Lin, 1998).

Usage

```
CoxBcv.rob(Y, Delta, X, ID)
```

Arguments

`Y`	vector of observed time-to-event data.
`Delta`	vector of censoring indicators.
`X`	matrix of marginal mean covariates with one column for one covariate (design matrix excluding intercept).
`ID`	vector of cluster identifiers.

Value

- coef - estimate of coefficients.
- exp(coef) - estimate of hazard ratio.
- ROB-var - uncorrected robust sandwich variance estimate of coef.

References

Spiekerman, C. F., & Lin, D. Y. (1998). Marginal regression models for multivariate failure time data. Journal of the American Statistical Association, 93(443), 1164-1175.

Examples

```
Y <- c(11,19,43,100,7,100,100,62,52,1,7,6)
Delta <- c(1,1,1,0,1,0,0,1,1,1,1,1)
X1 <- c(0,0,0,0,0,0,1,1,1,1,1,1)
X2 <- c(-19,6,-25,48,10,-25,15,22,17,-9,45,12)
ID <- c(1,1,2,2,3,3,4,4,5,5,6,6)

X <- X1
CoxBcv.rob(Y,Delta,X,ID)

X <- cbind(X1,X2)
CoxBcv.rob(Y,Delta,X,ID)
```

Index