

# Package ‘CoxBcv’

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**Type** Package

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

**Version** 0.0.1.0

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**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

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## R topics documented:

CoxBcv.fg	2
CoxBcv.fgmr	3
CoxBcv.kc	4
CoxBcv.kcmr	5
CoxBcv.mbn	6
CoxBcv.mbnmr	7
CoxBcv.md	8
CoxBcv.mdmr	9
CoxBcv.mr	10
CoxBcv.rob	11

<b>Index</b>	<b>13</b>
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CoxBcv.fg

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


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### 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)
```

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CoxBcv.kc	<i>Kauermann and Carroll (KC) bias-corrected sandwich variance estimator</i>
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### 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	<i>Morel, Bokossa, and Neerchal (MBN) bias-corrected sandwich variance estimator</i>
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### 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)
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)
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(0,0,0,0,0,0,0,1,1,1,1,1)
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

CoxBcv.fg, [2](#)  
CoxBcv.fgmr, [3](#)  
CoxBcv.kc, [4](#)  
CoxBcv.kcmr, [5](#)  
CoxBcv.mbn, [6](#)  
CoxBcv.mbnmr, [7](#)  
CoxBcv.md, [8](#)  
CoxBcv.mdmr, [9](#)  
CoxBcv.mr, [10](#)  
CoxBcv.rob, [11](#)