# Package 'firthb'

December 1, 2023

**Type** Package

**Title** Firth-type penalized estimation of the modified Poisson and linear regressions for multivariate analyses of risk ratio and risk difference

**Version** 1.1-1

**Date** 2023-12-01

**Maintainer** Satoshi Uno <suno@ism.ac.jp>

**Description** The modified Poisson and linear regression analyses have been standard methods for multivariate analyses of binary outcome data in estimating risk ratio and risk difference. Uno and Noma (2023+) <forthcoming> show these multivariate analyses possibly provide biased and/or imprecise estimates under small and sparse data situations (i.e., the "separation" condition). This package provides computational tools of the Firth-type penalized estimating methods for the modified Poisson and linear regressions proposed by Uno and Noma (2023+) <forthcoming>. Also, a bias-corrected sandwich variance estimator under small sample settings is available.

**Depends** R (>= 3.5.0)

**Imports** stats

**License** GPL-3

**Encoding** UTF-8

**LazyData** true

## R topics documented:



---

`firthb-package` *The 'firthb' package.*

---

### Description

Firth-type penalized estimation of the modified Poisson and linear regressions for multivariate analyses of risk ratio and risk difference.

## References

Cheung, Y. B. (2007). A modified least-squares regression approach to the estimation of risk difference. *American Journal of Epidemiology* **166**, 1337-1344.

Firth, D. (1993). Bias reduction of maximum likelihood estimates. *Biometrika* **80**, 27-38.

Uno, S. and Noma, H. (2023+). Firth-type penalized estimation of the modified Poisson and linear regressions for multivariate analyses of risk ratio and risk difference. Forthcoming.

Zou, G. (2004). A modified poisson regression approach to prospective studies with binary data. *American Journal of Epidemiology* **159**, 702-706.


---

`firthb` *Firth-type penalized estimation of the modified Poisson and linear regressions*

---

## Description

Implementing the Firth-type penalized estimation of the modified Poisson and linear regressions.

## Usage

```
firthb(y, X, measure)
```

## Arguments

| | |
|---|---|
| `y` | A vector of response variable. Please set the outcome variable as numeric (=0,1). |
| `X` | A design matrix of explanatory variables. Please set the variables as numeric. |
| `measure` | Type of effect measure: "RR" (risk ratio) or "RD" (risk difference) |

## Value

Results of the Firth-type penalized regression analysis.

- `EstimatedRR`: Regression coefficient estimates for risk ratio (if measure: RR).
- `EstimatedRD`: Regression coefficient estimates for risk difference (if measure: RD).
- `Low95pctCI`: Lower limits of the 95
- `Upp95pctCI`: Upper limits of the 95


## References

Cheung, Y. B. (2007). A modified least-squares regression approach to the estimation of risk difference. *American Journal of Epidemiology* **166**, 1337-1344.

Firth, D. (1993). Bias reduction of maximum likelihood estimates. *Biometrika* **80**, 27-38.

Uno, S. and Noma, H. (2023+). Firth-type penalized estimation of the modified Poisson and linear regressions for multivariate analyses of risk ratio and risk difference. Forthcoming.

Zou, G. (2004). A modified poisson regression approach to prospective studies with binary data. *American Journal of Epidemiology* **159**, 702-706.

## Examples

```
data(titanic)

y <- titanic$Death
X <- cbind(1, titanic$is_female, titanic$class_1, titanic$class_2, titanic$Age)

firthb(y=y,X=X,measure="RR")
firthb(y=y,X=X,measure="RD")
```

---

`titanic` *Survival outcomes for Titanic passengers*

---

## Description

- `PassengerId`: Passenger ID
- `Survived`: Passenger survival indicator
- `Pclass`: Passenger class
- `Name`: Name
- `Sex`: Sex
- `Age`: Age
- `SibSp`: Number of siblings/spouses aboard
- `Parch`: Number of parents/children aboard
- `Ticket`: Ticket number
- `Fare`: Passenger fare
- `Cabin`: Cabin
- `Embarked`: Port of embarkation
- `is_female`: Dummy variable of sex
- `class_1`: Dummy variable of Pclass
- `class_2`: Dummy variable of Pclass
- `class_3`: Dummy variable of Pclass
- `Death`: 1-`Survived`

## Usage

```
data(titanic)
```

## Format

A data frame with 130 rows and 17 variables

## References

https://www.kaggle.com/c/titanic/data

# Index