

# Package ‘firthb’

December 22, 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** 1.2-1

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**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, MASS

**License** GPL-3

**Encoding** UTF-8

**LazyData** true

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firthb-package	<i>The ‘firthb’ package.</i>
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## 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 methods for the modified Poisson and least-squares regression analyses in estimating 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.

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firthb	<i>Firth-type penalized estimation of the modified Poisson and linear regressions</i>
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## 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 methods for the modified Poisson and least-squares regression analyses in estimating risk ratio and risk difference. Forthcoming.
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**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")
```

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titanic*Survival outcomes for Titanic passengers*

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**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>

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