# Package 'logisticRR'

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**Type** Package

**Title** Adjusted Relative Risk from Logistic Regression

**Version** 0.3.0

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**Imports** stats, nnet

**Suggests** testthat, rmarkdown, knitr

**Description**

Adjusted odds ratio conditional on potential confounders can be directly obtained from logistic regression. However, those adjusted odds ratios have been widely incorrectly interpreted as a relative risk. As relative risk is often of interest in public health, we provide a simple code to return adjusted relative risks from logistic regression model under potential confounders.

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**Encoding** UTF-8

**LazyData** true

**RoxygenNote** 7.0.0

**VignetteBuilder** knitr

**URL** <https://github.com/youjin1207/logisticRR>

**NeedsCompilation** no

**Repository** CRAN

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## R topics documented:

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logisticRR                          *Calculate adjusted relative risks*

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### Description

When response variable is binary and exposure variable is binary or continuous, this function derives adjusted relative risks conditional on fixed other confounders' value from logistic regression.

### Usage

```
logisticRR(
  formula,
  basecov = 0,
  fixcov = NULL,
  data,
  boot = FALSE,
  n.boot = 100
)
```

### Arguments

| | |
|---|---|
| formula | a formula term that is passed into `glm()` having a form of `response ~ terms` where `response` is binary response vector and `terms` is a collection of terms connected by `'+'`. The first term of predictors will be used as a predictor of interest to calculate relative risks with respect to response variable. |
| basecov | a baseline value of exposure variable. Defaults to `0`. |
| fixcov | a data frame of fixed value for each of adjusted confounders. If there is no confounder other than an exposure variable of interest, `fixcov = NULL`; if `fixcov` is missing for covariates, they are all set to `0` (for numerical covariates) or first levels (for factor covariates). |
| data | a data frame containing response variable and all the terms used in `formula`. |
| boot | a logical value whether bootstrap samples are generated or not. Defaults to `FALSE`. |
| n.boot | if `boot = TRUE`, the number of bootstrap samples. Defaults to `100`. |

### Value

| | |
|---|---|
| fit | an object of class `glm`. |
| RR | (conditional) relative risk in response under exposure at baseline (`basecov`) and `basecov + 1`. |
| delta.var | estimated variance of relative risk (RR) using Delta method. |
| boot.rr | if `boot = TRUE`, a vector of RR's using bootstrap samples. |
| boot.var | estimated sampled variance using bootstraps if `boot = TRUE`. |
| fix.cov | a data frame of fixed value for each of adjsuted confounders. |

## Author(s)

Youjin Lee

## Examples

```
n <- 500
set.seed(1234)
X <- rbinom(n, 1, 0.3)
W <- rbinom(n, 1, 0.3);
W[sample(1:n, n/3)] = 2
Y <- rbinom(n, 1, plogis(X - W))
dat <- as.data.frame(cbind(Y, X, W))
result <- logisticRR(Y ~ X + W, basecov = 0, data = dat,
                     boot = TRUE, n.boot = 200)
```

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multinRR                    *Inference on relative risk under multinomial logistic regression*

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## Description

Inference on relative risk under multinomial logistic regression

## Usage

```
multinRR(
  formula,
  basecov,
  comparecov,
  fixcov = NULL,
  data,
  boot = FALSE,
  n.boot = 100
)
```

## Arguments

| | |
|---|---|
| formula | a formula term that is passed into multinom() where response should be a factor having K different levels. Every term appearing in the formula should be well-defined as a column of data. Reference response should be specified as the first level. |
| basecov | a baseline value of exposure variable. Defaults to 0. |
| comparecov | a value of exposure variable for comparison. Defaults to the first level. |
| fixcov | a data frame of fixed value for each of adjusted confounders. If there is no confounder other than the exposure variable of interest, fixcov = NULL; if fixcov is missing for existing covariates, they are all set to 0 (for numerical covariates) or to the first level (for factor covariates). |

| data | a data frame containing response variable and all the terms used in `formula`. |
|---|---|
| boot | a logical value whether bootstrap samples are generated or not. Defaults to `FALSE`. |
| n.boot | if boot = TRUE, the number of bootstrap samples. Defaults to `100`. |

## Value

| fit | an object of class `multinom`. |
|---|---|
| RRR | (adjusted) relative risk ratio of K different responses compared to reference response under exposure at baseline (`basecov`) and `basecov` + 1. |
| RR | (adjusted) relative risk of K different responses under exposure at baseline (`basecov`) and `basecov` + 1. |
| delta.var | estimated variance of relative risk (RR) using Delta method. |
| boot.rr | if boot = TRUE, a vector of RR's using bootstrap samples. |
| boot.rrr | if boot = TRUE, a vector of relative risk ratio (RRR)'s using bootstrap samples. |
| boot.var | estimated sampled variance using bootstraps if boot = TRUE. |
| fix.cov | a data frame of fixed value for each of adjsuted confounders. |

## Author(s)

Youjin Lee

## Examples

```
n <- 500
set.seed(1234)
X <- rbinom(n, 1, 0.3)
W <- rbinom(n, 1, 0.3)
W[sample(1:n, n/3)] = 2
Y <- rbinom(n, 1, plogis(X - W))
multiY <- ifelse(X == 1 , rbinom(n, 1, 0.7) + Y, rbinom(n, 1, 0.2) + Y)
print(table(multiY))
dat <- as.data.frame(cbind(multiY, X, W))
dat$W <- as.factor(dat$W)
result <- multinRR(multiY ~ W + X, basecov = 0, comparecov = 1,
data = dat, boot = TRUE)
print(apply(result$boot.rr, 2, sd)) # estimated standard errors using Delta method
print(sqrt(result$delta.var)) # estimated standard errors using bootstrap
```

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multiRR *Inference on relative risk under multinomial logistic regression*

---

### Description

Inference on relative risk under multinomial logistic regression

### Usage

```
multiRR(formula, basecov = 0, fixcov = NULL, data, boot = FALSE, n.boot = 100)
```

### Arguments

| | |
|---|---|
| formula | a formula term that is passed into `multinom()` where response should be a factor having K different levels. Every term appearing in the formula should be well-defined as a column of `data`. Reference response should be specified as the first level. |
| basecov | a baseline value of exposure variable. Defaults to `0`. |
| fixcov | a data frame of fixed value for each of adjusted confounders. If there is no confounder other than the exposure variable of interest, `fixcov = NULL`; if `fixcov` is missing for existing covariates, they are all set to `0` (for numerical covariates) or to the first level (for factor covariates). |
| data | a data frame containing response variable and all the terms used in `formula`. |
| boot | a logical value whether bootstrap samples are generated or not. Defaults to `FALSE`. |
| n.boot | if `boot = TRUE`, the number of bootstrap samples. Defaults to `100`. |

### Value

| | |
|---|---|
| fit | an object of class `multinom`. |
| RRR | (adjusted) relative risk ratio of K different responses compared to reference response under exposure at baseline (`basecov`) and `basecov + 1`. |
| RR | (adjusted) relative risk of K different responses under exposure at baseline (`basecov`) and `basecov + 1`. |
| delta.var | estimated variance of relative risk (RR) using Delta method. |
| boot.rr | if `boot = TRUE`, a vector of RR's using bootstrap samples. |
| boot.rrr | if `boot = TRUE`, a vector of relative risk ratio (RRR)'s using bootstrap samples. |
| boot.var | estimated sampled variance using bootstraps if `boot = TRUE`. |
| fix.cov | a data frame of fixed value for each of adjsuted confounders. |

### Author(s)

Youjin Lee

## Examples

```
n <- 500
set.seed(1234)
X <- rbinom(n, 1, 0.3)
W <- rbinom(n, 1, 0.3)
W[sample(1:n, n/3)] = 2
Y <- rbinom(n, 1, plogis(X - W))
dat <- as.data.frame(cbind(Y, X, W))
result <- multiRR(W ~ X + Y, basecov = 0, data = dat, boot = TRUE, n.boot = 100)
print(apply(result$boot.rr, 2, sd)) # estimated standard errors using Delta method
print(sqrt(result$delta.var)) # estimated standard errors using bootstrap
```

---

nominalRR                    *Calculate adjusted relative risks under nominal exposure variable*

---

## Description

When response variable is binary and exposure variable is categorical this function derives adjusted
relative risks conditional on fixed other confounders' value from logistic regression.

## Usage

```
nominalRR(
  formula,
  basecov = NULL,
  comparecov = NULL,
  fixcov = NULL,
  data,
  boot = FALSE,
  n.boot = 100
)
```

## Arguments

| | |
|---|---|
| formula | a formula term that is passed into glm() having a form of response ~ terms where response is binary response vector and terms is a collection of terms connected by '+'. The first term of predictors will be used as a predictor of interest to calculate relative risks with respect to response variable. |
| basecov | a baseline value of exposure variable. Defaults to the first level. |
| comparecov | a value of exposure variable for comparison. Defaults to the first level. |
| fixcov | a data frame of fixed value for each of adjusted confounders. If there is no confounder other than an exposure variable of interest, fixcov = NULL; if fixcov is missing for covariates, they are all set to 0 (for numerical covariates) or first levels (for factor covariates). |
| data | a data frame containing response variable and all the terms used in formula. |

| boot | a logical value whether bootstrap samples are generated or not. Defaults to `FALSE`. |
|---|---|
| `n.boot` | if boot = `TRUE`, the number of bootstrap samples. Defaults to `100`. |

## Value

| fit | an object of class `glm`. |
|---|---|
| RR | (conditional) relative risk in response under exposure at baseline (`basecov`) and `comparecov`. |
| `delta.var` | estimated variance of relative risk (RR) using Delta method. |
| `boot.rr` | if boot = TRUE, a vector of RR's using bootstrap samples. |
| `boot.var` | estimated sampled variance using bootstraps if boot = TRUE. |
| `fix.cov` | a data frame of fixed value for each of adjsuted confounders. |

## Author(s)

Youjin Lee

## Examples

```
n <- 500
set.seed(1234)
W <- rbinom(n, 1, 0.3); W[sample(1:n, n/3)] = 2
dat <- as.data.frame(W)
dat$X <- sample( c("low", "medium", "high"), size = n, replace = TRUE)
dat$Y <- ifelse(dat$X == "low", rbinom(n, 1, plogis(W + 0.5)),
                ifelse(dat$X == "medium", rbinom(n, 1, plogis(W + 0.2)),
                rbinom(n, 1, plogis(W - 0.4)) ))
dat$X <- as.factor(dat$X)
result <- nominalRR(Y ~ X + W, basecov = "low", comparecov = "high", data = dat,
boot = TRUE, n.boot = 200)
```

---

| printmnRR | *Print adjusted relative risk using multinomial logistic regression under nominal exposure variable.* |
|---|---|

---

## Description

Print adjusted relative risk using multinomial logistic regression under nominal exposure variable.

## Usage

```
printmnRR(formula, basecov, comparecov, fixcov = NULL, data)
```

## Arguments

| | |
|---|---|
| formula | a formula term that is passed into multinom() where response should be a factor having K different levels. Every term appearing in the formula should be well-defined as a column of data. Reference response should be specified as the first level. |
| basecov | a baseline value of exposure variable. Defaults to 0. |
| comparecov | a value of exposure variable for comparison. Defaults to the first level. |
| fixcov | a data frame of fixed value for each of adjusted confounders. If there is no confounder other than the exposure variable of interest, fixcov = NULL; if fixcov is missing for existing covariates, they are all set to 0 (for numerical covariates) or to the first level (for factor covariates). |
| data | a data frame containing response variable and all the terms used in formula. |

## Value

| | |
|---|---|
| fit | an object of class multinom. |
| RRR | (adjusted) relative risk ratio of K different responses compared to reference response under exposure at baseline (basecov) and basecov + 1. |
| RR | (adjusted) relative risk of K different responses under exposure at baseline (basecov) and basecov + 1. |
| delta.var | estimated variance of relative risk (RR) using Delta method. |
| fix.cov | a data frame of fixed value for each of adjsuted confounders. |

## Author(s)

Youjin Lee

## Examples

```
n <- 500
set.seed(1234)
X <- rbinom(n, 1, 0.3)
W <- rbinom(n, 1, 0.3)
W[sample(1:n, n/3)] = 2
Y <- rbinom(n, 1, plogis(X - W))
multiY <- ifelse(X == 1 , rbinom(n, 1, 0.7) + Y, rbinom(n, 1, 0.2) + Y)
print(table(multiY))
dat <- as.data.frame(cbind(multiY, X, W))
dat$W <- as.factor(dat$W)
result <- printmnRR(multiY ~ W + X, basecov = 0, comparecov = 1, data = dat)
```

---

| printmRR | *Print adjusted relative risk using multinomial logistic regression under binary or ordinal exposure variable.* |

---

## Description

Print adjusted relative risk using multinomial logistic regression under binary or ordinal exposure variable.

## Usage

```
printmRR(formula, basecov = 0, fixcov = NULL, data)
```

## Arguments

| | |
|---|---|
| formula | a formula term that is passed into multinom() where response should be a factor having K different levels. Every term appearing in the formula should be well-defined as a column of data. Reference response should be specified as the first level. |
| basecov | a baseline value of exposure variable. Defaults to 0. |
| fixcov | a data frame of fixed value for each of adjusted confounders. If there is no confounder other than the exposure variable of interest, fixcov = NULL; if fixcov is missing for existing covariates, they are all set to 0 (for numerical covariates) or to the first level (for factor covariates). |
| data | a data frame containing response variable and all the terms used in formula. |

## Value

| | |
|---|---|
| fit | an object of class multinom. |
| RRR | (adjusted) relative risk ratio of K different responses compared to reference response under exposure at baseline (basecov) and basecov + 1. |
| RR | (adjusted) relative risk of K different responses under exposure at baseline (basecov) and basecov + 1. |
| delta.var | estimated variance of relative risk (RR) using Delta method. |
| fix.cov | a data frame of fixed value for each of adjsuted confounders. |

## Author(s)

Youjin Lee

## Examples

```
n <- 500
set.seed(1234)
X <- rbinom(n, 1, 0.3)
W <- rbinom(n, 1, 0.3)
W[sample(1:n, n/3)] = 2
Y <- rbinom(n, 1, plogis(X - W))
dat <- as.data.frame(cbind(Y, X, W))
result <- printmRR(W ~ X + Y, basecov = 0, data = dat)
```

---

printnRR                    *Print adjusted relative risk under nominal exposure variable.*

---

## Description

Print adjusted relative risk under nominal exposure variable.

## Usage

```
printnRR(formula, basecov, comparecov, fixcov = NULL, data)
```

## Arguments

| | |
|---|---|
| formula | a formula term that is passed into `glm()` having a form of `response ~ terms` where `response` is binary response vector and `terms` is a collection of terms connected by `'+'`. The first term of predictors will be used as a predictor of interest to calculate relative risks with respect to response variable. |
| basecov | a baseline value of exposure variable. Defaults to the first level. |
| comparecov | a value of exposure variable for comparison. Defaults to the first level. |
| fixcov | a data frame of fixed value for each of adjusted confounders. If there is no confounder other than an exposure variable of interest, `fixcov = NULL`; if `fixcov` is missing for covariates, they are all set to 0 (for numerical covariates) or first levels (for factor covariates). |
| data | a data frame containing response variable and all the terms used in `formula`. |

## Value

| | |
|---|---|
| fit | an object of class `glm`. |
| RR | (adjusted) relative risk in response under exposure at baseline (`basecov`) and `comparecov`. |
| delta.var | estimated variance of relative risk (RR) using Delta method. |
| fix.cov | a data frame of fixed value for each of adjsuted confounders. |

## Author(s)

Youjin Lee

## Examples

```
n <- 500
set.seed(1234)
W <- rbinom(n, 1, 0.3); W[sample(1:n, n/3)] = 2
dat <- as.data.frame(W)
dat$X <- sample( c("low", "medium", "high"), size = n, replace = TRUE)
dat$Y <- ifelse(dat$X == "low", rbinom(n, 1, plogis(W + 0.5)),
                ifelse(dat$X == "medium", rbinom(n, 1, plogis(W + 0.2)),
                rbinom(n, 1, plogis(W - 0.4)) ))
dat$X <- as.factor(dat$X)
result <- printnRR(Y ~ X + W, basecov = "high", comparecov = "low", data = dat)
```

---

printRR                          *Print adjusted relative risk under binary or ordinal exposure variable.*

---

## Description

Print adjusted relative risk under binary or ordinal exposure variable.

## Usage

```
printRR(formula, basecov = 0, fixcov = NULL, data)
```

## Arguments

| | |
|---|---|
| formula | a formula term that is passed into glm() having a form of response ~ terms where response is binary response vector and terms is a collection of terms connected by '+'. The first term of predictors will be used as a predictor of interest to calculate relative risks with respect to response variable. |
| basecov | a baseline value of exposure variable. Defaults to 0. |
| fixcov | a data frame of fixed value for each of adjusted confounders. If there is no confounder other than an exposure variable of interest, fixcov = NULL; if fixcov is missing for covariates, they are all set to 0 (for numerical covariates) or first levels (for factor covariates). |
| data | a data frame containing response variable and all the terms used in formula. |

## Value

| | |
|---|---|
| fit | an object of class glm. |
| RR | (adjusted) relative risk in response under exposure at baseline (basecov) and basecov + 1. |
| delta.var | estimated variance of relative risk (RR) using Delta method. |
| fix.cov | a data frame of fixed value for each of adjsuted confounders. |

## Examples

```
n <- 500
set.seed(1234)
X <- rbinom(n, 1, 0.3)
W <- rbinom(n, 1, 0.3)
W[sample(1:n, n/3)] = 2
Y <- rbinom(n, 1, plogis(X - W))
dat <- as.data.frame(cbind(Y, X, W))
result <- printRR(Y ~ X + W, basecov = 0, data = dat)
```

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