

# Package ‘GLIDE’

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**Type** Package

**Title** Global and Individual Tests for Direct Effects

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**Description** Global and individual tests for pleiotropy and direct effects in Mendelian randomization studies. Refer to J. Y. Dai, U. Peters, X. Wang, J. Kocarnik et al. AJE (2018) <[doi:10.1093/aje/kwy177](https://doi.org/10.1093/aje/kwy177)>.

**Depends** R (>= 2.10)

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**LazyLoad** no

**License** GPL (>= 2)

**NeedsCompilation** yes

**Repository** CRAN

**Suggests** rmarkdown, knitr

**VignetteBuilder** knitr

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`checkdata`*A function used to check the core inputs of function glide*

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**Description**

It is used to check the core inputs of function glide

**Usage**

```
checkdata(formula, exposure_coeff, genotype_columns, data)
```

**Arguments**

`formula`            An an object of class "formula": outcome ~ adjusting covariates.

`exposure_coeff`    A named numeric vector or a one-column dataframe for the external coefficients for genotype-exposure associations.

`genotype_columns`    An integer vector, column indices of data in which genotype data are stored.

`data`                A data frame composed of formula-related components and snp genotype columns.

**Value**

No return value, would generate error messages if input data are not right.

**Author(s)**

James Y. Dai and X. Wang

**Examples**

```
#load an example data; it includes a dataframe "simdat" and a one-column dataframe "coeff"
data(simdata)
simdat=simdata$simdat
coeff=simdata$coeff
formula=as.formula("outcome~age+sex+pc1+pc2+pc3")
genotype_columns=which(grepl("^SNP", colnames(simdat)))
checkdata(formula=formula, exposure_coeff=coeff, genotype_columns, data=simdat)
```

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glide	<i>Evaluate individual and global pleiotropy among genotypes being used as instrumental variables in Mendelian randomization studies.</i>
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### Description

Glide is a function to perform global and individual tests for assessing direct effects in Mendelian randomization studies.

### Usage

```
glide(formula, exposure_coeff=NULL, genotype_columns=NULL, data,
      np=100000, qcutoff=0.2, parallel=TRUE, corenumber=1, verbose=TRUE)
```

### Arguments

formula	An object of class "formula": outcome ~ adjusting covariates, specifying the logistic regression of a binary study outcome with respect to covariates being adjusted for in addition to genotype data.
exposure_coeff	A named numeric vector or a one-column dataframe for the external regression coefficients for genotype-exposure associations. These coefficients are typically derived from previous genome-wide association studies. All the names or row-names must be found in "genotype_columns" (specified below) columns of the input data.
genotype_columns	An integer vector that contains column indices of data columns in which genotype data are stored.
data	A data frame composed of formula-related variables and SNP genotype columns.
np	An integer for the number of observations in the parametric simulation being generated to compute expected p-values and q-values.
qcutoff	The q-value cutoff to declare significance of the direct effects of individual variants. The default value is set to be 0.2.
parallel	If TRUE, use parallel foreach to speed up computation.
corenumber	An integer to set the number of computer cores used in parallel computation. If the requested number of cores is greater than number of cores available, GLIDE will use the latter number.
verbose	If TRUE, print on screen the computing time spent in each step of GLIDE.

### Details

This function fits a logistic regression for each SNP being evaluated for instrumental variables, regressing outcome on one genotype at a time and adjusting covariates as specified in the formula (outcome ~ adjusting covariates). The p-values for the genotypes derived from these regression models were compared to the distribution of simulation-based null p-values to declare significance of individual variant and global pleiotropy. See Dai et al. (2017) for details of the algorithm.

**Value**

A data frame containing observed p-value, expected null p-value, family wise error rate (FWER), q-value, genetic association with exposure, and variance of the estimated association of each SNP.

**Author(s)**

James Y. Dai and X. Wang

**References**

J. Y. Dai, U. Peters, X. Wang, J. Kocarnik, J. et al. Diagnostics of pleiotropy in Mendelian randomization studies: Global and individual tests for direct effects. *Am J Epidemiol* 187(12):2672-80, 2018.

**Examples**

```
##load an example data.
data(simdata)
#The example dataset is a list composed of two dataframes.
#simat stores 20,000 observations of 81 variables, including outcome, 5 adjusting covariates,
#and 75 SNPs.
simdat=simdata$simdat
#coeff stores the 75 external regression coefficients.
coeff=simdata$coeff
#We define the regression formula for outcome and adjusting covariates
formula=as.formula("outcome~age+sex+pc1+pc2+pc3")
#We next define the columns in simdat that contain genotype data
genotype_columns=which(grepl("^SNP",colnames(simdat)))

##run glide
out=glide(formula=formula,exposure_coeff=coeff,genotype_columns,data=simdat,np=100000,
qcutoff=0.2,parallel=TRUE,corenumber=1,verbose=TRUE)

##use more cores
out=glide(formula=formula,exposure_coeff=coeff,genotype_columns,data=simdat,np=100000,
qcutoff=0.2,parallel=TRUE,corenumber=2,verbose=TRUE)
```

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plot.egger

*A function used to draw Egger plot*

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**Description**

It is used to draw MR-Egger regression plot.

**Usage**

```
## S3 method for class 'egger'
plot(x,exposure_coeff,qcutoff=0.2,xlab="Genetic association with the exposure",
      ylab="Genetic association with the outcome",...)
```

**Arguments**

x	x is a dataframe, it is the outcome of the glide function.
exposure_coeff	A named numeric vector or a one-column dataframe for the external regression coefficients for genotype-exposure associations. These coefficients are typically derived from previous genome-wide association studies. All the names or row-names must be found in "genotype_columns" (specified below) columns of the input data.
qcutoff	qcutoff is the q-value cutoff.
xlab	xlab is the default x label.
ylab	ylab is the default y label.
...	the rest of plot arguments.

**Value**

No return value, the Egger plot will be generated.

**Author(s)**

James Y. Dai and X. Wang

**Examples**

```
##first generate output using the glide function
#load an example data
data(simdata)
simdat=simdata$simdat
coeff=simdata$coeff

formula=as.formula("outcome~age+sex+pc1+pc2+pc3")
genotype_columns=which(grepl("^SNP",colnames(simdat)))

#run glide
out=glide(formula=formula,exposure_coeff=coeff,genotype_columns,data=simdat,np=100000,
          qcutoff=0.2,parallel=TRUE,corenumber=1,verbose=TRUE)

##draw the Egger plot
plot.egger(out,exposure_coeff=coeff)
```

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plot.glide                      *A function used to draw the q-q plot*

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### Description

It is used to draw the q-q plot

### Usage

```
## S3 method for class 'glide'  
plot(x,qcutoff=0.2,xlab="Expected null p-values (log base 10)",  
     ylab="Observed p-values (log base 10)",...)
```

### Arguments

x	x is a dataframe, it is the outcome of the glide function.
qcutoff	qcutoff is the q-value cutoff.
xlab	xlab is the default x label.
ylab	ylab is the default y label.
...	the rest plot arguments.

### Value

No return value, q-q plot will be generated.

### Author(s)

James Y. Dai and X. Wang

### Examples

```
##first generate output using the glide function  
#load an example data  
data(simdata)  
simdat=simdata$simdat  
coeff=simdata$coeff  
  
formula=as.formula("outcome~age+sex+pc1+pc2+pc3")  
genotype_columns=which(grepl("^SNP",colnames(simdat)))  
  
#run glide  
out=glide(formula=formula,exposure_coeff=coeff,genotype_columns,data=simdat,np=100000,  
qcutoff=0.2,parallel=TRUE,corenumber=1,verbose=TRUE)  
  
##draw the plot  
plot.glide(out)
```

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remove_missingdata	<i>A function used to remove missing data</i>
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**Description**

It is used to remove samples which have NA/missing data in covariates.

**Usage**

```
remove_missingdata(data)
```

**Arguments**

data                    data is a dataframe.

**Value**

row index of the input data which don't have missing values.

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simdata	<i>An example dataset to demonstrate the usage of GLIDE</i>
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**Description**

An example simulation dataset used to demonstrate the usage of GLIDE. It is a list composed of a dataframe "simdat" and a dataframe "coeff"

**Usage**

```
data("simdata")
```

**Format**

coeff is a one-column dataframe. It consists of exposure coefficients of genotypes of 75 SNPs. simdat is a data frame consisting of 20000 observations. It has 81 columns, with 75 columns for genotypes of 75 SNPs and 6 columns of following covariates:

age an integer vector to indicate age

sex a factor vector to indicate gender

pc1 a numeric vector of the first principal component of genotypes

pc2 a numeric vector of the second principal component of genotypes

pc3 a numeric vector of the third principal component of genotypes

outcome a factor vector to indicate the outcome, 1/0

**Examples**

```
data("simdata")  
ls()
```

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