

Package ‘swgee’

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Type Package

Title Simulation Extrapolation Inverse Probability Weighted
Generalized Estimating Equations

Version 1.4

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Imports stats, graphics, gee, geopack, mvtnorm,

LazyLoad yes

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Description Simulation extrapolation and inverse probability weighted generalized estimating equations method for longitudinal data with missing observations and measurement error in covariates. References: Yi, G. Y. (2008) <[doi:10.1093/biostatistics/kxm054](https://doi.org/10.1093/biostatistics/kxm054)>; Cook, J. R. and Stefanski, L. A. (1994) <[doi:10.1080/01621459.1994.10476871](https://doi.org/10.1080/01621459.1994.10476871)>; Little, R. J. A. and Rubin, D. B. (2002, ISBN:978-0-471-18386-0).

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swgee-package

*Simulation Extrapolation Inverse Probability Weighted Generalized Estimating Equations***Description**

Simulation extrapolation and inverse probability weighted generalized estimating equations method for longitudinal data with missing observations and measurement error in covariates. References: Yi, G. Y. (2008) <doi:10.1093/biostatistics/kxm054>; Cook, J. R. and Stefanski, L. A. (1994) <doi:10.1080/01621459.1994.10476871>; Little, R. J. A. and Rubin, D. B. (2002, ISBN:978-0-471-18386-0).

Details

The DESCRIPTION file:

```
Package:      swgee
Type:        Package
Title:       Simulation Extrapolation Inverse Probability Weighted Generalized Estimating Equations
Version:     1.4
Date:       2019-03-20
Imports:    stats, graphics, gee, geepack, mvtnorm,
LazyLoad:   yes
Author:     Juan Xiong <jxiong@szu.edu.cn>, Grace Y. Yi <yyi@uwaterloo.ca>
Maintainer: Juan Xiong <jxiong@szu.edu.cn>
Description: Simulation extrapolation and inverse probability weighted generalized estimating equations method for longitu
License:    GPL-3
```

Index of help topics:

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| BMI | BMI dataset |
| getsimexest | getsimexest |
| plot.swgee | plot.swgee |
| print.summary.swgee | print.summary.swgee |
| print.swgee | print.swgee |
| summary.swgee | summary.swgee |
| swgee | Simulation Extrapolation Inverse Probability Weighted Generalized Estimating Equations |
| swgee-package | Simulation Extrapolation Inverse Probability Weighted Generalized Estimating Equations |

Implementation of the SIMEX inverse probability weighted GEE method for longitudinal data with missing observations and measurement error in covariates

Author(s)

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References

Cook, J.R. and Stefanski, L.A. (1994) Simulation-extrapolation estimation in parametric measurement error models. *Journal of the American Statistical Association*, 89, 1314-1328.

Carroll, R.J., Ruppert, D., Stefanski, L.A. and Crainiceanu, C. (2006) Measurement error in nonlinear models: A modern perspective., Second Edition. London: Chapman and Hall.

Yi, G. Y. (2008) A simulation-based marginal method for longitudinal data with dropout and mis-measured covariates. *Biostatistics*, 9, 501-512.

See Also

[geeglm](#)

BMI

BMI dataset

Description

a subset of the the Framingham Heart Study Data. The data set consists of measurements of 100 patients from a series of exams with 5 assessments for each individual. Individual's obesity status, age, systolic blood pressure (SBP) and cholesterol level (CHOL) are collected at each assessment.

Usage

```
data("BMI")
```

Format

A data frame with 500 observations on the following 7 variables.

`id` a numeric vector for subject id

`visit` a numeric vector for assessment time

`age` a numeric vector of age

`sbp` a numeric vector of systolic blood pressure

`chol` a numeric vector of cholesterol level

`bbmi` an indicator of obesity status(1=yes, 0=no)

`O` an indicator of observed measurement(1=yes, 0=no)

Details

The author thanks Boston University and the National Heart, Lung, and Blood Institute (NHLBI) for providing the data set from the Framingham Heart Study (No. N01-HC-25195) in the illustration. The Framingham Heart Study is conducted and supported by the NHLBI in collaboration with Boston University. This package was not prepared in collaboration with investigators of the Framingham Heart Study and does not necessarily reflect the opinions or views of the Framingham Heart Study, Boston University, or NHLBI.

Source

Strug, L., Sun, L. and Corey, M. (2003). The genetics of cross-sectional and longitudinal body mass index. *BMC Genetics* 4 (Suppl 1), S14

Yoo, Y. J., Huo, Y., Ning, Y., Gordon, D., Finch, S. and Mendell, N. R. (2003). Power of maximum HLOD tests to detect linkage to obesity genes. *BMC Genetics* 4 (Suppl 1), S16.

References

Cook, J.R. and Stefanski, L.A. (1994) Simulation-extrapolation estimation in parametric measurement error models. *Journal of the American Statistical Association*, 89, 1314-1328.

Carrol, R.J., Ruppert, D., Stefanski, L.A. and Crainiceanu, C. (2006) Measurement error in nonlinear models: A modern perspective., Second Edition. London: Chapman and Hall.

Yi, G. Y. (2008) A simulation-based marginal method for longitudinal data with dropout and mis-measured covariates. *Biostatistics*, 9, 501-512.

Examples

```
data(BMI)
```

```
getsimexest
```

```
getsimexest
```

Description

extract the estimates for every lambda

Usage

```
getsimexest(indata)
```

Arguments

indata swgee object from the function swgee

Details

internal function for the extrapolation step

Author(s)

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References

- Cook, J.R. and Stefanski, L.A. (1994) Simulation-extrapolation estimation in parametric measurement error models. *Journal of the American Statistical Association*, 89, 1314-1328.
- Carroll, R.J., Ruppert, D., Stefanski, L.A. and Crainiceanu, C. (2006) Measurement error in nonlinear models: A modern perspective., Second Edition. London: Chapman and Hall.
- Yi, G. Y. (2008) A simulation-based marginal method for longitudinal data with dropout and mis-measured covariates. *Biostatistics*, 9, 501-512.

plot.swgee

plot.swgee

Description

Produce the plot of the quadratic extrapolation curve for any covariables with measurement error in the swgee model

Usage

```
## S3 method for class 'swgee'
## S3 method for class 'swgee'
plot(x, covariate, ...)
```

Arguments

| | |
|-----------|--|
| x | object of class 'swgee' |
| covariate | covariates specified in the formula |
| ... | further arguments passed to or from other functions. |

Value

Plot the simulation and extrapolation step

Author(s)

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References

- Cook, J.R. and Stefanski, L.A. (1994) Simulation-extrapolation estimation in parametric measurement error models. *Journal of the American Statistical Association*, 89, 1314-1328.
- Carroll, R.J., Ruppert, D., Stefanski, L.A. and Crainiceanu, C. (2006) Measurement error in nonlinear models: A modern perspective., Second Edition. London: Chapman and Hall.
- Yi, G. Y. (2008) A simulation-based marginal method for longitudinal data with dropout and mis-measured covariates. *Biostatistics*, 9, 501-512.

Examples

```

require(gee)
require(mvtnorm)
data(BMI)
bmidata <- BMI

rho <- 0
sigma1 <- 0.5
sigma2 <- 0.5

sigma <- matrix(0,2,2)
sigma[1,1] <- sigma1*sigma1
sigma[1,2] <- rho*sigma1*sigma2
sigma[2,1] <- sigma[1,2]
sigma[2,2] <- sigma2*sigma2

set.seed(1000)
##swgee method #####
output2 <- swgee(bbmi~sbp+chol+age, data = bmidata, id = id,
  family = binomial(link="logit"), corstr = "independence",
  missingmodel = 0~bbmi+sbp+chol+age, SIMEXvariable = c("sbp", "chol"),
  SIMEX.err = sigma, repeated = FALSE, B = 20, lambda = seq(0, 2, 0.5))

summary(output2)

plot(output2, "sbp")

```

```
print.summary.swgee  print.summary.swgee
```

Description

Summary method for class "swgee"

Usage

```

## S3 method for class 'swgee'
## S3 method for class 'summary.swgee'
print(x, ...)

```

Arguments

```

x          object of class 'swgee'
...       further arguments passed to or from other functions.

```

Value

Print summary nicely

Author(s)

Juan Xiong<jxiong@szu.edu.cn>, Grace Y. Yi<yiyi@uwaterloo.ca>

References

- Cook, J.R. and Stefanski, L.A. (1994) Simulation-extrapolation estimation in parametric measurement error models. *Journal of the American Statistical Association*, 89, 1314-1328.
- Carrol, R.J., Ruppert, D., Stefanski, L.A. and Crainiceanu, C. (2006) Measurement error in nonlinear models: A modern perspective., Second Edition. London: Chapman and Hall.
- Yi, G. Y. (2008) A simulation-based marginal method for longitudinal data with dropout and mis-measured covariates. *Biostatistics*, 9, 501-512.

print.swgee

print.swgee

Description

Summary method for class "swgee"

Usage

```
## S3 method for class 'swgee'  
## S3 method for class 'swgee'  
print(x, ...)
```

Arguments

x object of class 'swgee'
... further arguments passed to or from other functions.

Value

Print swgee object nicely

Author(s)

Juan Xiong<jxiong@szu.edu.cn>, Grace Y. Yi<yiyi@uwaterloo.ca>

References

- Cook, J.R. and Stefanski, L.A. (1994) Simulation-extrapolation estimation in parametric measurement error models. *Journal of the American Statistical Association*, 89, 1314-1328.
- Carrol, R.J., Ruppert, D., Stefanski, L.A. and Crainiceanu, C. (2006) Measurement error in nonlinear models: A modern perspective., Second Edition. London: Chapman and Hall.
- Yi, G. Y. (2008) A simulation-based marginal method for longitudinal data with dropout and mis-measured covariates. *Biostatistics*, 9, 501-512.

`summary.swgee``summary.swgee`

Description

Summary method for class "swgee"

Usage

```
## S3 method for class 'swgee'  
summary(object, ...)
```

Arguments

`object` object of class 'swgee'
`...` further arguments passed to or from other functions.

Details

The function `summary.swgee` computes and returns a list of summary statistics of the response process and missing process

Value

summary estimates for parameters associated with response process and missing process

Author(s)

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References

Cook, J.R. and Stefanski, L.A. (1994) Simulation-extrapolation estimation in parametric measurement error models. *Journal of the American Statistical Association*, 89, 1314-1328.

Carrol, R.J., Ruppert, D., Stefanski, L.A. and Crainiceanu, C. (2006) Measurement error in nonlinear models: A modern perspective., Second Edition. London: Chapman and Hall.

Yi, G. Y. (2008) A simulation-based marginal method for longitudinal data with dropout and mis-measured covariates. *Biostatistics*, 9, 501-512.

| | |
|-------|---|
| swgee | <i>Simulation Extrapolation Inverse Probability Weighted Generalized Estimating Equations</i> |
|-------|---|

Description

Implementation of the SIMEX inverse probability weighted GEE method for longitudinal data with missing observations and measurement error in covariates

Usage

```
swgee(formula, data = parent.frame(), id, family = family,
      corstr = "independence", missingmodel, SIMEXvariable, SIMEX.err,
      repeated = FALSE, repind = NULL, B = 50, lambda = seq(0, 2, 0.5))
```

Arguments

| | |
|---------------|--|
| formula | specifies the model to be fitted, with the variables coming with data. This argument has the same format as the formula argument in the function <code>geeglm</code> from package geepack , of the form <code>response ~ predictors</code> . See documentation of <code>geeglm</code> and <code>formula</code> for details. |
| data | an optional data frame in which to interpret the variables occurring in the formula, along with the <code>id</code> variable. |
| id | a vector which identifies the clusters. The length of <code>id</code> should be the same as the number of observations. Data are assumed to be sorted so that observations on a cluster are contiguous rows for all entities in the formula. |
| family | a family object as the family argument in the function <code>gee</code> from package gee . Families supported in <code>swgee</code> are <code>gaussian</code> , <code>binomial</code> , <code>poisson</code> , <code>Gamma</code> , and <code>quasi</code> . See documentation of <code>gee</code> and <code>family</code> for details. |
| corstr | a character string specifying the correlation structure. The following are permitted: <code>"independence"</code> , <code>"fixed"</code> , <code>"stat_M_dep"</code> , <code>"non_stat_M_dep"</code> , <code>"exchangeable"</code> , <code>"AR-M"</code> and <code>"unstructured"</code> . |
| missingmodel | specifies the missing model to be fitted, of the form <code>O~ predictors</code> , where <code>O</code> is the missing data indicator. |
| SIMEXvariable | a vector of characters containing the name of the covariates subject to measurement error. |
| SIMEX.err | specifies the covariance matrix of measurement errors in error model. |
| repeated | This is the indicator if there are repeated measurements for the covariates with measurement error. The default value is <code>FALSE</code> . |
| repind | This is the index of the repeated measurement variables for each covariate with measurement error. It has an R list form. If <code>repeated = TRUE</code> , <code>repind</code> must be specified. |
| B | the number of simulated samples for the simulation step. The default is set to be 50. |
| lambda | a vector of lambdas for which the simulation step should be done. |

Details

The quadratic extrapolation method is implemented as described in Cook and Stefanski

Value

| | |
|---------------|---|
| call | the function call |
| family | family |
| corstr | correlation structure |
| SIMEXvariable | a vector of characters containing the name of the covariates subject to measurement error |
| B | the number of iterations |
| beta | the coefficients associated with the response process |
| alpha | the coefficients associated with the missing process |
| simex.plot | the estimates for every B and lambda |

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References

Cook, J.R. and Stefanski, L.A. (1994) Simulation-extrapolation estimation in parametric measurement error models. *Journal of the American Statistical Association*, 89, 1314-1328.

Carrol, R.J., Ruppert, D., Stefanski, L.A. and Crainiceanu, C. (2006) Measurement error in nonlinear models: A modern perspective., Second Edition. London: Chapman and Hall.

Yi, G. Y. (2008) A simulation-based marginal method for longitudinal data with dropout and mis-measured covariates. *Biostatistics*, 9, 501-512.

See Also

[geeglm](#)

Examples

```
require(gee)
data(BMI)
bmidata <- BMI

rho <- 0
sigma1 <- 0.5
sigma2 <- 0.5

sigma <- matrix(0,2,2)
sigma[1,1] <- sigma1*sigma1
sigma[1,2] <- rho*sigma1*sigma2
sigma[2,1] <- sigma[1,2]
sigma[2,2] <- sigma2*sigma2
```

```
set.seed(1000)
##naive method, ignore missingness and measurement error
output1 <- gee(bbmi~sbp+chol+age, id = id, data = bmidata,
              family = binomial(link="logit"), corstr = "independence")

##swgee method #####
output2 <- swgee(bbmi~sbp+chol+age, data = bmidata, id = id,
                family = binomial(link="logit"),corstr = "independence",
                missingmodel = 0~bbmi+sbp+chol+age, SIMEXvariable = c("sbp", "chol"),
                SIMEX.err = sigma, repeated = FALSE, B = 20, lambda = seq(0, 2, 0.5))

summary(output2)
```

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