

# Package ‘JGEE’

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**Type** Package

**Title** Joint Generalized Estimating Equation Solver

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**Description**

Fits two different joint generalized estimating equation models to multivariate longitudinal data.

**License** GPL (>= 2)

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JGEE-package

*Joint Generalized Estimating Equation Solver*

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## Description

This package considers analysis of multivariate longitudinal data via two different joint generalized estimating equation (JGEE) models. While the first JGEE model assumes regression coefficients shared by responses, the second JGEE model assumes response-specific regression coefficients. Since the later model uses response-specific regression coefficients, this model is more flexible compared to the former model. As a result of this, the later model can be used to analyse the multivariate longitudinal data with mixed outcomes as well. On the other hand, the working correlation matrix in both JGEE models is decomposed as within-subject correlation and multivariate response correlation matrices through Kronecker product. a large menu for modelling these two correlation matrices are offered.

## Details

This package consists of two different functions. `JGee1` function fits a joint generalized estimating equation model to multivariate longitudinal data where the regression coefficients are shared by the different response types. `JGee2` function fits a joint generalized estimating equation model to multivariate longitudinal data where the regression coefficients are response-specific.

## Author(s)

Gul Inan

Maintainer: Gul Inan

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JGee1	<i>Function to fit a joint generalized estimating equation model with shared regression coefficients</i>
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## Description

This function fits a joint generalized estimating equation model to multivariate longitudinal data with mono-type responses where the regression coefficients are shared by the different response types.

## Usage

```
JGee1(formula, id, data, nr, na.action = NULL,  
family = gaussian(link = "identity"), corstr1 = "independence",  
Mv = NULL, corstr2 = "independence", beta_int = NULL, R1 = NULL,  
R2 = NULL, scale.fix = FALSE, scale.value = 1, maxiter = 25,  
tol = 10^-3,  
silent = FALSE)
```

**Arguments**

formula	A formula expression in the form of response~predictors.
id	A vector for identifying subjects.
data	A data frame which stores the variables in formula with id variable.
nr	Number of multiple responses.
na.action	A function to remove missing values from the data. Only na.omit is allowed here.
family	A family object: a list of functions and expressions for defining link and variance functions. Families supported in JGee1 are binomial, gaussian, gamma and poisson. The links, which are not available in gee, is not available here. The default family is gaussian.
corstr1	A character string, which specifies the type of within-subject correlation structure. Structures supported in JGee1 are "AR-1", "exchangeable", "fixed", "independence", "stat_M_dep", "non_stat_M_dep", and "unstructured". The default corstr1 type is "independence".
Mv	If either "stat_M_dep", or "non_stat_M_dep" is specified in corstr1, then this assigns a numeric value for Mv. Otherwise, the default value is NULL.
corstr2	A character string, which specifies the type of multivariate response correlation structure. Structures supported in JGee1 are "exchangeable", "independence", and "unstructured". The default corstr2 type is "independence".
beta_int	User specified initial values for regression parameters. The default value is NULL.
R1	If corstr1="fixed" and corstr2="fixed" are specified, then R1 is a square matrix of dimension maximum cluster size containing the user specified correlation. Otherwise, the default value is NULL.
R2	If corstr1="fixed" and corstr2="fixed" are specified, then R2 is a square matrix of dimension nr size containing the user specified correlation. Otherwise, the default value is NULL.
scale.fix	A logical variable; if true, the scale parameter is fixed at the value of scale.value. The default value is FALSE.
scale.value	If scale.fix=TRUE, this assigns a numeric value to which the scale parameter should be fixed.
maxiter	The number of iterations that is used in the estimation algorithm. The default value is 25.
tol	The tolerance level that is used in the estimation algorithm. The default value is $10^{-3}$ .
silent	A logical variable; if true, the regression parameter estimates at each iteration are printed. The default value is FALSE.

**Value**

An object class of JGee1 representing the fit.

**Note**

The structures "non\_stat\_M\_dep" and "unstructured" are valid only when the data is balanced.

**See Also**

[JGee2](#)

**Examples**

```
## Not run:
data(MSCMsub)
mydata=MSCMsub

#MSCM stduy data layout requires some arrangement for model fitting.

N=167
nt=4
nr=2

yvec=matrix(0,N*nt*nr,1)
xmat=matrix(0,N*nt*nr,8)

for(i in 1:N) {
  for(j in 1:nt){
    yvec[j+(i-1)*nr*nt]=mydata[j+(i-1)*nt,2]
    yvec[j+(i-1)*nr*nt+nt]=mydata[j+(i-1)*nt,3]
  }
}

for(i in 1:N) {
  for(j in 1:nt){
    for(k in 4:11){
      xmat[j+(i-1)*nr*nt,(k-3)]=mydata[j+(i-1)*nt,k]
      xmat[j+(i-1)*nr*nt+nt,(k-3)]=mydata[j+(i-1)*nt,k]
    }
  }
}

id=rep(1:N, each=(nt*nr))
mydatanew=data.frame(id,yvec,xmat)
head(mydatanew)
colnames(mydatanew)=c("id","resp","chlth","csex","education","employed",
"houseize","married","mhlth","race")
head(mydatanew)

formulaj1=resp~chlth+csex+education+employed+houseize+married+
mhlth+race

fitjgee1=JGee1(formula=formulaj1,id=mydatanew[,1],data=mydatanew, nr=2,
na.action=NULL, family=binomial(link="logit"), corstr1="exchangeable",
Mv=NULL, corstr2="independence", beta_int=NULL, R1=NULL, R2=NULL,
scale.fix= FALSE, scale.value=1, maxiter=25, tol=10^-3,
```

```

silent=FALSE)

summary(fitjgee1)

names(summary(fitjgee1))

summary(fitjgee1)$working.correlation1

## End(Not run)

```

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JGee2	<i>Function to fit a joint generalized estimating equation model with response-specific regression coefficients</i>
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### Description

This function fits a joint generalized estimating equation model to multivariate longitudinal data with mono-type or mixed responses where the regression coefficients are response-specific.

### Usage

```

JGee2(formula, id, data, nr, na.action = NULL,
family = list(gaussian(link = "identity"), gaussian(link = "identity")),
corstr1 = "independence", Mv = NULL, corstr2 = "independence",
beta_int = NULL, R1 = NULL, R2 = NULL, scale.fix = FALSE, scale.value = 1,
maxiter = 25, tol = 10^-3, silent = FALSE)

```

### Arguments

formula	A formula expression in the form of <code>cbind(res1, ..., resnr)~predictors</code> .
id	A vector for identifying subjects.
data	A data frame which stores the variables in formula with id variable.
nr	Number of multiple responses.
na.action	A function to remove missing values from the data. Only <code>na.omit</code> is allowed here.
family	A family object: a list of functions and expressions for defining link and variance functions. Families supported in JGee2 are <code>binomial</code> , <code>gaussian</code> , <code>gamma</code> and <code>poisson</code> . The links, which are not available in <code>gee</code> , is not available here. The default family is <code>gaussian</code> .
corstr1	A character string, which specifies the type of within-subject correlation structure. Structures supported in JGee2 are <code>"AR-1"</code> , <code>"exchangeable"</code> , <code>"fixed"</code> , <code>"independence"</code> , <code>"stat_M_dep"</code> , <code>"non_stat_M_dep"</code> , and <code>"unstructured"</code> . The default <code>corstr1</code> type is <code>"independence"</code> .
Mv	If either <code>"stat_M_dep"</code> , or <code>"non_stat_M_dep"</code> is specified in <code>corstr1</code> , then this assigns a numeric value for <code>Mv</code> . Otherwise, the default value is <code>NULL</code> .

corstr2	A character string, which specifies the type of multivariate response correlation structure. Structures supported in JGee2 are "exchangeable", "independence", and "unstructured". The default corstr2 type is "independence".
beta_int	User specified initial values for regression parameters. The default value is NULL.
R1	If corstr1="fixed" and corstr2="fixed" are specified, then R1 is a square matrix of dimension maximum cluster size containing the user specified correlation. Otherwise, the default value is NULL.
R2	If corstr1="fixed" and corstr2="fixed" are specified, then R2 is a square matrix of dimension nr size containing the user specified correlation. Otherwise, the default value is NULL.
scale.fix	A logical variable; if true, the scale parameter is fixed at the value of scale.value. The default value is FALSE.
scale.value	If scale.fix=TRUE, this assigns a numeric value to which the scale parameter should be fixed.
maxiter	The number of iterations that is used in the estimation algorithm. The default value is 25.
tol	The tolerance level that is used in the estimation algorithm. The default value is $10^{-3}$ .
silent	A logical variable; if true, the regression parameter estimates at each iteration are printed. The default value is FALSE.

**Value**

An object class of JGee2 representing the fit.

**Note**

The structures "non\_stat\_M\_dep" and "unstructured" are valid only when the data is balanced.

**See Also**

[JGee1](#)

**Examples**

```
## Not run:

#check the data
data(MSCMsub)

#rename it
mydata=MSCMsub

#check the column labels for formula object
head(mydata)

#prepare formula object before model fitting
formulaj2=cbind(stress,illness)~chlth+csex+education+employed+housize+married+mhlth+race
```

```
#prepare family object before model fitting
familyj2=list(binomial(link="logit"),binomial(link="logit"))

#fit the model
fitjgee2=JGee2(formula=formulaj2,id=mydata[,1],data=mydata,nr=2,na.action=NULL,
family=familyj2, corstr1="exchangeable", Mv=NULL, corstr2="unstructured",
beta_int=rep(0,18), R1=NULL, R2=NULL, scale.fix=FALSE, scale.value=1, maxiter=30,
tol=10^-3, silent=FALSE)

#check the object names returned by fitjgee2
names(fitjgee2)

#check the object names returned by summary(fitjgee2)
names(summary(fitjgee2))

#get the coefficients
summary(fitjgee2)$coefficients

#get the within-subject correlation matrix
summary(fitjgee2)$working.correlation1

#get the multivariate response correlation matrix
summary(fitjgee2)$working.correlation2

#get the overall working correlation matrix
summary(fitjgee2)$working.correlation

## End(Not run)
```

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MSCMsub

*Mother's Stress and Children's Morbidity (MSCM) study data*

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## Description

In Mother's Stress and Children's Morbidity (MSCM) study, Alexander and Markowitz (1986) investigated the relationship between maternal employment and paediatric health care utilization due to considerable changes in social and demographic characteristics in the US since 1950. A total of 167 mothers and their preschool children (ages of between 18 months and 5 years) were enrolled in the MSCM study. At the beginning of the study, mothers were asked to provide demographic and domestic information about them such as education level, employment and marriage status, children's gender and race, maternal and child's health status at baseline and the household size, which are all categorical and time-invariant variables. Afterwards, the mothers were asked to record their maternal stress and child's illness status, whether present or not, in a health diary over a 28-day follow-up period. Information on these variables along with two binary responses, namely, mother's stress status and child's illness status for the days from 25 to 28 are presented here.

**Usage**

```
data("MSCMsub")
```

**Format**

A data frame with 668 observations on the following 11 variables.

id A vector for classifying subjects.

stress Mother's stress status at day t: 0=absence, 1=presence.

illness Child's illness status at day t: 0=absence, 1=presence.

chlth Child's health status at baseline: 0=very poor/poor, 1=fair, 2=good, 3=very good.

csex Child's gender: 0=male, 1=female.

education Mother's education level: 0=high school or less, 1=high school graduate.

employed Mother's employment status: 0=unemployed, 1=employed.

housize Size of the household: 0=2-3 people, 1=more than 3 people.

married Marriage status of the mother: 0=other, 1=married.

mhlth Mother's health status at baseline: 0=very poor/poor, 1=fair, 2=good, 3=very good.

race Child's race: 0=white, 1=non-white.

**Source**

<http://faculty.washington.edu/heagerty/Books/AnalysisLongitudinal/datasets.html>

**References**

Alexander, C.S. and Markowitz, R. (1986). Maternal employment and use of pediatric clinic services. *Medical Care*, **24**(2), 13–22.



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