Package 'geeM'

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Type Package

Title Solve Generalized Estimating Equations

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Melanie Prague [ctb] (Suggested code to fix weighting)

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Depends Matrix

Imports stats, methods

Suggests geepack, testthat, MuMIn

Description GEE estimation of the parameters in mean structures with possible
correlation between the outcomes. User-specified mean link and variance
functions are allowed, along with observation weighting. The 'M' in the name
'geeM' is meant to emphasize the use of the Matrix package, which allows for an
implementation based fully in R.

License GPL-3

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geem   *Fit Generalized Estimating Equations*

Description

Calculate coefficients and nuisance parameters using generalized estimating equations. Link and Variance functions can be specified by the user. Similar to [glm].

Usage

```
geem(formula, id, waves=NULL, data = parent.frame(), family = gaussian,
 corstr = "independence", Mv = 1, weights = NULL, corr.mat = NULL, init.beta = NULL,
 init.alpha = NULL, init.phi = 1, scale.fix = FALSE, nodummy=FALSE, sandwich = TRUE,
 useP = TRUE, maxit = 20, tol = 1e-05)
```

Arguments

formula	a formula expression similar to that for [glm], of the form response~predictors. An offset is allowed, as in glm.
id	a vector identifying the clusters. By default, data are assumed to be sorted such that observations in a cluster are in consecutive rows and higher numbered rows in a cluster are assumed to be later. If NULL, then each observation is assigned its own cluster.
waves	an integer vector identifying components of a cluster. For example, this could be a time ordering. If integers are skipped within a cluster, then dummy rows with weight 0 are added in an attempt to preserve the correlation structure (except if corstr = "exchangeable" or "independent"). This can be skipped by setting nodummy=TRUE.
data	an optional data frame containing the variables in the model.
family	will determine the link and variance functions. The argument can be one of three options: a family object, a character string, or a list of functions.
	For more information on how to use family objects, see [family].
	If the supplied argument is a character string, then the string should correspond to one of the family objects.
	In order to define a link function, a list must be created with the components (LinkFun, VarFun, InvLink, InvLinkDeriv), all of which are vectorized functions. If the components in the list are not named as
	(LinkFun, VarFun, InvLink, InvLinkDeriv), then geem assumes that the functions are given in that order. LinkFun and VarFun are the link and variance functions. InvLink and InvLinkDeriv are the inverse of the link function and the derivative of the inverse of the link function and so are decided by the choice of the link function.
corstr	a character string specifying the correlation structure. Allowed structures are: "independence", "exchangeable", "ar1", "m-dependent", "unstructured", "fixed", and "userdefined". Any unique substring may be supplied. If

	"fixed" or *"userdefined"*, then corr.mat must be specified. If *"m-dependent"*, then Mv is relevant.
Mv	for *"m-dependent"*, the value for m.
weights	A vector of weights for each observation. If an observation has weight 0, it is excluded from the calculations of any parameters. Observations with a NA anywhere (even in variables not included in the model) will be assigned a weight of 0. Note that these weights are now the same as PROC GEE weights and not PROC GENMOD.
corr.mat	the correlation matrix for *"fixed"*. Matrix should be symmetric with dimensions >= the maximum cluster size. If the correlation structure is *"userdefined"*, then this is a matrix describing which correlations are the same.
init.beta	an optional vector with the initial values of beta. If not specified, then the intercept will be set to InvLink(mean(response)). init.beta must be specified if not using an intercept.
init.alpha	an optional scalar or vector giving the initial values for the correlation. If provided along with Mv>1 or unstructured correlation, then the user must ensure that the vector is of the appropriate length.
init.phi	an optional initial overdispersion parameter. If not supplied, initialized to 1.
scale.fix	if set to TRUE, then the scale parameter is fixed at the value of init.phi.
nodummy	if set to TRUE, then dummy rows will not be added based on the values in waves.
sandwich	if TRUE, calculate robust variance.
useP	if set to FALSE, do not use the n-p correction for dispersion and correlation estimates, as in Liang and Zeger. This can be useful when the number of observations is small, as subtracting p may yield correlations greater than 1.
maxit	maximum number of iterations.
tol	tolerance in calculation of coefficients.

Details

Users may specify functions for link and variance functions, but the functions must be vectorized functions. See [Vectorize](#) for an easy way to vectorize functions. Vectorize should be used sparingly, however, as it can lead to fairly slow function calls. Care must be taken to ensure that convergence is possible with non-standard functions.

Offsets must be specified in the model formula, as in glm.

For the *"userdefined"* correlation option, the function accepts a matrix with consecutive integers. geem only looks at the upper triangle of the matrix. Any entry given as 0 will be fixed at 0. All entries given as 1 will be assumed to be the same as each other and will be assumed to be possibly different from entries with a 2, and so on.

If observations are dropped because they have a weight of 0, then the denominator for the moment estimates of the correlation matrices are calculated using the number of non-zero Pearson residuals for the correlation structures unstructured, userdefined and m-dependent with Mv>1. Therefore residuals numerically equal to 0 may cause problems in the calculation of correlation parameters.

Value

An object of class "geem" representing the fit.

Author(s)

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See Also

glm, formula, family

Examples

```
### Generated Negative Binomial Data
generatedata <- function(beta,alpha,gamma,X,T,n)  {
    mean.vec <- exp(crossprod(t(X),beta))
    y <- matrix(0,nrow=n,ncol=T)
    y[,1] <- rnbinom(n,mu = mean.vec[1],size=mean.vec[1]/gamma)
    for (i in 1:n)  {
      for (t in 2:T)  {
          innovation.mean <- mean.vec[t] - alpha*(sqrt(mean.vec[t]*mean.vec[t-1]))
          I <- rnbinom(1,mu= innovation.mean,size= innovation.mean/gamma)
          first.shape <- alpha*sqrt(mean.vec[t]*mean.vec[t-1])/gamma
          second.shape <- mean.vec[t-1]/gamma - first.shape
          u <- rbeta(1,shape1 = first.shape,shape2=second.shape)
          a <- rbinom(1,size=y[i,t-1],prob=u)
          y[i,t] = a + I
      }
    }
    longform <- c(t(y))
    print(apply(y,2,mean))
  simdata <- data.frame(count = longform, time = rep(X[,2],times=n),subject=rep(c(1:n),each=T))
    return(simdata)
}

X <- cbind(rep(1,5),c(-.5,-.25,0,.25,.5))
testdat <- generatedata(beta=c(1,.5),alpha=.2,gamma=.5,X=X,T=5,n=3000)
far1 <- geem(count~ time, id=subject ,data = testdat, family=poisson,
corstr="ar1")

### Ohio respiratory data from geepack
if(require(geepack)){
data("ohio", package="geepack")
resplogit <- geem(resp ~ age + smoke + age:smoke, id=id, data = ohio, family = binomial,
corstr = "m-dep" , Mv=1)

  LinkFun <- function(arg){qcauchy(arg)}
  InvLink <- function(arg){pcauchy(arg)}
  InvLinkDeriv <- function(arg){dcauchy(arg)}
  VarFun <- function(arg){arg*(1-arg)}
  FunList <- list(LinkFun, VarFun, InvLink, InvLinkDeriv)
```

```
  respcauchit <- geem(resp ~ age + smoke + age:smoke, id=id, data = ohio, family = FunList,
  corstr = "m-dep" , Mv=1)
}

### Seizure data from geepack
if(require(geepack)){
data("seizure", package="geepack")
seiz.l <- reshape(seizure,
varying=list(c("base","y1", "y2", "y3", "y4")),
v.names="y", times=0:4, direction="long")
seiz.l <- seiz.l[order(seiz.l$id, seiz.l$time),]
seiz.l$t <- ifelse(seiz.l$time == 0, 8, 2)
seiz.l$x <- ifelse(seiz.l$time == 0, 0, 1)

seiz <- geem(y~ x + trt + x:trt+ offset(log(t)), id=id,data = seiz.l,
family = poisson, corstr = "exchangeable")
}
```

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