

Package ‘GLMcat’

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Title Generalized Linear Models for Categorical Responses

Version 0.2.4

Description In statistical modeling, there is a wide variety of regression models for categorical dependent variables (nominal or ordinal data); yet, there is no software embracing all these models together in a uniform and generalized format. Following the methodology proposed by Peyhardi, Trottier, and Guédon (2015) <[doi:10.1093/biomet/asv042](https://doi.org/10.1093/biomet/asv042)>, we introduce ‘GLMcat’, an R package to estimate generalized linear models implemented under the unified specification (r, F, Z). Where r represents the ratio of probabilities (reference, cumulative, adjacent, or sequential), F the cumulative cdf function for the linkage, and Z, the design matrix.

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Encoding UTF-8

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LazyData true

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Imports Rcpp, stats, stringr

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Author Lorena León [aut, cre],
Jean Peyhardi [aut],
Catherine Trottier [aut]

Maintainer Lorena León <ylorenaleonv@gmail.com>

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anova.glmcat	<i>Anova for a fitted glmcat model object</i>
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Description

Compute an analysis of deviance table for one fitted glmcat model object.

Usage

```
## S3 method for class 'glmcat'
anova(object, ...)
```

Arguments

object	an object of class "glmcat".
...	additional arguments.

coef.glmcat	<i>Model coefficients of a fitted glmcat model object</i>
-------------	---

Description

Returns the coefficient estimates of the fitted glmcat model object.

Usage

```
## S3 method for class 'glmcat'
coef(object, na.rm = FALSE, ...)
```

Arguments

object	an fitted object of class glmcat.
na.rm	TRUE for NA coefficients to be removed, default is FALSE.
...	additional arguments affecting the coef method.

confint.glmcat	<i>Confidence intervals for parameters of a fitted glmcat model object</i>
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Description

Computes confidence intervals from a fitted glmcat model object for all the parameters.

Usage

```
## S3 method for class 'glmcat'
confint(object, parm, level, ...)
```

Arguments

object	an fitted object of class glmcat.
parm	a numeric or character vector indicating which regression coefficients should be displayed
level	the confidence level.
...	other parameters.

control_glmcat *Control parameters for glmcat models*

Description

Set control parameters for glmcat models.

Usage

```
control_glmcat(maxit = 25, epsilon = 1e-06, beta_init = NA)
```

Arguments

maxit	the maximum number of the Fisher's Scoring Algorithm iterations. Defaults to 25.
epsilon	a double to change update the convergence criterion of GLMcat models.
beta_init	an appropriate sized vector for the initial iteration of the algorithm.

discrete_cm *Discrete Choice Models*

Description

Fit discrete choice models which require data in long form. For each individual (or decision maker), there are multiple observations (rows), one for each of the alternatives the individual could have chosen. A group of observations of the same individual is a "case". Remark that each case represents a single statistical observation although it comprises multiple observations.

Usage

```
discrete_cm(
  formula,
  case_id,
  alternatives,
  reference,
  alternative_specific = NA,
  data,
  cdf = list(),
  intercept = "standard",
  normalization = 1,
  control = list()
)
```

Arguments

formula	a symbolic description of the model to be fit. An expression of the form $y \sim$ predictors is interpreted as a specification that the response y is modelled by a linear predictor specified symbolically by model. A particularity for the formula is that for the case-specific variables, the user can define a specific effect for a category.
case_id	a string with the name of the column that identifies each case.
alternatives	a string with the name of the column that identifies the vector of alternatives the individual could have chosen.
reference	a string indicating the reference category
alternative_specific	a character vector with the name of the explanatory variables that are different for each case, these are the alternative specific variables. By default, the case specific variables are the explanatory variables that are not identify in here, but that are part of the formula.
data	a dataframe (in a long format) object in R, with the dependent variable as factor.
cdf	The inverse distribution function to be used as part of the link function. If the distribution has no parameters to specify then it should be entered as a string indicating the name, e.g., <code>cdf = "normal"</code> , the default value is <code>cdf = "logistic"</code> . If there are parameters to specify then a list must be entered, so far this would only be the case for Student's distribution which would be <code>list("student", df=2)</code> , and for the non-central distribution of student, <code>list("noncentralt", df=2, mu=1)</code> ,
intercept	if "conditional" then the design will be equivalent to the conditional logit model
normalization	the quantile to use for the normalization of the estimated coefficients where the logistic distribution is used as the base cumulative distribution function.
control	<code>maxit</code> : the maximum number of iterations for the Fisher scoring algorithm. <code>epsilon</code> : a double with to fix the epsilon value <code>beta_init</code> : an appropriate sized vector for the initial iteration of the algorithm

Details

Family of models for Discrete Choice

Note

For these models it is not allowed to exclude the intercept.

Examples

```
library(GLMcat)
data(TravelChoice)
discrete_cm(formula = choice ~ hinc + gc + invt,
case_id = "indv", alternatives = "mode", reference = "air",
data = TravelChoice, alternative_specific = c("gc", "invt"),
cdf = "logistic")
```

DisturbedDreams	<i>Severity of disturbed dreams</i>
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Description

Boy's disturbed dreams benchmark dataset drawn from a study that cross-classified boys by their age, and the severity (not severe, severe 1, severe 2, very severe) of their disturbed dreams (Maxwell, 1961).

Usage

```
data(DisturbedDreams)
```

Format

A dataframe containing :

Age Individuals age

Level Severity level: Not.severe, Severe.1, Severe.2, Very.severe.

References

Maxwell, A.E. (1961) *Analyzing qualitative data*, Methuen London, 73.

Examples

```
data(DisturbedDreams)
```

extractAIC.glmcat	<i>Extract AIC from a fitted glmcat model object</i>
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Description

Method to compute the (generalized) Akaike An Information Criterion for a fitted object of class glmcat.

Usage

```
## S3 method for class 'glmcat'  
extractAIC(fit, ...)
```

Arguments

fit an fitted object of class glmcat.
... further arguments (currently unused in base R).

Description

Estimate generalized linear models implemented under the unified specification (ratio,cdf,Z) where ratio represents the ratio of probabilities (reference, cumulative, adjacent, or sequential), cdf the cumulative distribution function for the linkage, and Z the design matrix which must be specified through the parallel and the threshold arguments.

Usage

```
glmcat(
  formula,
  data,
  ratio = c("reference", "cumulative", "sequential", "adjacent"),
  cdf = list(),
  parallel = NA,
  categories_order = NA,
  ref_category = NA,
  threshold = c("standard", "symmetric", "equidistant"),
  control = list(),
  normalization = 1,
  ...
)
```

Arguments

formula	a symbolic description of the model to be fit. An expression of the form $y \sim$ predictors is interpreted as a specification that the response y is modelled by a linear predictor specified symbolically by model.
data	a dataframe object in R, with the dependent variable as factor.
ratio	a string indicating the ratio (equivalently to the family) options are: reference, adjacent, cumulative and sequential. Default value is reference.
cdf	The inverse distribution function to be used as part of the link function. If the distribution has no parameters to specify then it should be entered as a string indicating the name, e.g., <code>cdf = "normal"</code> , the default value is <code>cdf = "logistic"</code> . If there are parameters to specify then a list must be entered, so far this would only be the case for Student's distribution which would be <code>list("student", df=2)</code> , and for the non-central distribution of student, <code>list("noncentral", df=2, mu=1)</code> .
parallel	a character vector indicating the name of the variables with a parallel effect. If variable is categorical, specify the name and the level of the variable as a string "namelevel".

categories_order	a character vector indicating the incremental order of the categories: c("a", "b", "c"); a<b<c. Alphabetical order is assumed by default. Order is relevant for adjacent, cumulative and sequential ratio.
ref_category	a string indicating the reference category. Proper option for models with reference ratio.
threshold	restriction to impose on the thresholds, options are: standard, equidistant or symmetric (Valid only for the cumulative ratio).
control	maxit: the maximum number of iterations for the Fisher scoring algorithm. epsilon: a double to change update the convergence criterion of GLMcat models. beta_init: an appropriate sized vector for the initial iteration of the algorithm.
normalization	the quantile to use for the normalization of the estimated coefficients where the logistic distribution is used as the base cumulative distribution function.
...	additional arguments.

Details

Fitting models for categorical responses

References

Peyhardi J, Trottier C, Guédon Y (2015). "A new specification of generalized linear models for categorical responses." *Biometrika*, 102(4), 889–906. doi:10.1093/biomet/asv042.

Examples

```
data(DisturbedDreams)
ref_log_com <- glmcat(formula = Level ~ Age, data = DisturbedDreams,
  ref_category = "Very.severe",
  cdf = "logistic", ratio = "reference")
```

logLik.glmcat

Log-likelihood of a fitted glmcat model object

Description

Extract Log-likelihood of a fitted glmcat model object.

Usage

```
## S3 method for class 'glmcat'
logLik(object, ...)
```

Arguments

object an fitted object of class glmcat.
... additional arguments affecting the loglik.

nobs.glmcat	<i>Number of observations of a fitted glmcat model object</i>
-------------	---

Description

Extract the number of observations of the fitted glmcat model object.

Usage

```
## S3 method for class 'glmcat'  
nobs(object, ...)
```

Arguments

object	an fitted object of class glmcat.
...	additional arguments affecting the nobs method.

plot.glmcat	<i>Plot method for a fitted codeglmcat model object</i>
-------------	---

Description

plot of the log-likelihood profile for a fitted glmcat model object.

Usage

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

Arguments

x	an object of class glmcat.
...	additional arguments.

predict.glmcat	<i>Predict method for a fitted glmcat model object</i>
----------------	--

Description

Obtains predictions of a fitted glmcat model object.

Usage

```
## S3 method for class 'glmcat'
predict(object, newdata, type, ...)
```

Arguments

object	a fitted object of class glmcat.
newdata	optionally, a data frame in which to look for the variables involved in the model. If omitted, the fitted linear predictors are used.
type	the type of prediction required. The default is "prob" which gives the probabilities, the other option is "linear.predictor" which gives predictions on the scale of the linear predictor.
...	further arguments. The default is "prob" which gives the probabilities, the other option is "linear.predictor" which gives predictions on the scale of the linear predictor.

print.anova.glmcat	<i>Printing Anova for glmcat model fits</i>
--------------------	---

Description

print.anova method for GLMcat objects.

Usage

```
## S3 method for class 'anova.glmcat'
print(x, digits = max(getOption("digits") - 2, 3), ...)
```

Arguments

x	an object of class "glmcat".
digits	the number of digits in the printed table.
...	additional arguments affecting the summary produced.

print.glmcat	<i>Print method for a fitted codeglmcat model object</i>
--------------	--

Description

print method for a fitted glmcat model object.

Usage

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

Arguments

x	an object of class glmcat.
...	additional arguments.

print.summary.glmcat	<i>Printing a fitted glmcat model object</i>
----------------------	--

Description

print.summary method for GLMcat objects.

Usage

```
## S3 method for class 'summary.glmcat'  
print(x, digits = max(3, getOption("digits") - 3), ...)
```

Arguments

x	an object of class "glmcat".
digits	the number of digits in the printed table.
...	additional arguments affecting the summary produced.

 step.glmcat

Stepwise for a glmcat model object

Description

Stepwise for a glmcat model object based on the AIC.

Usage

```
## S3 method for class 'glmcat'
step(object, scope, direction, trace, steps)
```

Arguments

object	an fitted object of class glmcat.
scope	defines the range of models examined in the stepwise search (same as in the step function of the stats package). This should be either a single formula, or a list containing components upper and lower, both formulae.
direction	the mode of the stepwise search.
trace	to print the process information.
steps	the maximum number of steps.

 summary.glmcat

Summary method for a fitted glmcat model object

Description

Summary method for a fitted glmcat model object.

Usage

```
## S3 method for class 'glmcat'
summary(object, normalized = FALSE, correlation = FALSE, ...)
```

Arguments

object	an fitted object of class glmcat.
normalized	if normalized is TRUE summary method yields the normalized coefficients.
correlation	TRUE to print the Correlation Matrix.
...	additional arguments affecting the summary produced.

terms.glmcat	<i>Terms of a fitted glmcat model object</i>
--------------	--

Description

Returns the terms of a fitted glmcat model object.

Usage

```
## S3 method for class 'glmcat'
terms(x, ...)
```

Arguments

x	an object of class glmcat.
...	additional arguments.

TravelChoice	<i>Travel Mode Choice</i>
--------------	---------------------------

Description

The data set contains 210 observations on mode choice for travel between Sydney and Melbourne, Australia.

Usage

```
data(TravelChoice)
```

Format

A dataframe containing :

indv Id of the individual

mode available options: air, train, bus or car

choice a logical vector indicating as TRUE the transportation mode chosen by the traveler As category-specific variables:

invt travel time in vehicle

gc generalized cost measure

ttme terminal waiting time for plane, train and bus; 0 for car

invc in vehicle cost As case-specific variables:

hinc household income

psize traveling group size in mode chosen

Source

Download from on-line (18/09/2020) complements to Greene, W.H. (2011) *Econometric Analysis*, Prentice Hall, 7th Edition <http://people.stern.nyu.edu/wgreene/Text/Edition7/TableF18-2.csv>, Table F18-2.

References

Greene, W.H. and D. Hensher (1997) *Multinomial logit and discrete choice models in* Greene, W. H. (1997) *LIMDEP version 7.0 user's manual revised*, Plainview, New York econometric software, Inc .

Examples

```
data(TravelChoice)
```

vcov.glmcat

Variance-Covariance Matrix for a fitted glmcat model object

Description

Returns the variance-covariance matrix of the main parameters of a fitted glmcat model object.

Usage

```
## S3 method for class 'glmcat'  
vcov(object,...)
```

Arguments

object an object of class glmcat.
... additional arguments.

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