Package 'ordinalCont'

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Title Ordinal Regression Analysis for Continuous Scales

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Description A regression framework for response variables which are continuous self-rating scales such as the Visual Analog Scale (VAS) used in pain assessment, or the Linear Analog Self-Assessment (LASA) scales in quality of life studies. These scales measure subjects' perception of an intangible quantity, and cannot be handled as ratio variables because of their inherent nonlinearity. We treat them as ordinal variables, measured on a continuous scale. A function (the g function, currently the generalized logistic function) connects the scale with an underlying continuous latent variable. The link function is the inverse of the CDF of the assumed underlying distribution of the latent variable. Currently the logit link, which corresponds to a standard logistic distribution, is implemented.

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`ordinalCont-package` *ordinalCont-package*

Description

ordinalCont-package

Details

Ordinal regression analysis is a convenient tool for analyzing ordinal response variables in the presence of covariates. We extend this methodology to the case of continuous self-rating scales such as the Visual Analog Scale (VAS) used in pain assessment, or the Linear Analog Self-Assessment (LASA) scales in quality of life studies. Subjects are typically given a linear scale of 100 mm and asked to put a mark where they perceive themselves. These scales measure subjects' perception of an intangible quantity, and cannot be handled as ratio variables because of their inherent non-linearity. Instead we treat them as ordinal variables, measured on a continuous scale. We express the likelihood in terms of a function (the "g function") connecting the scale with an underlying continuous latent variable. In the current version the g function is taken as the generalized logistic function (Richards 1959). This has 3 parameters: `M`, the offset, `B`, the slope, and `T`, the symmetry of the curve. The link function is the inverse of the CDF of the assumed underlying distribution of the latent variable. Currently the logit link, which corresponds to a standard logistic distribution, is implemented. (This implies a proportional odds model.) The likelihood is maximized using `optim {stats}` with a quasi-Newton method (`"BFGS"`). Fixed-effects models are implemented in the function `ocm`, and mixed models in `ocmm`.

Author(s)

Maurizio Manuguerra, Gillian Heller

References

Manuguerra M, Heller GZ (2010). Ordinal Regression Models for Continuous Scales, *The International Journal of Biostatistics*: 6(1), Article 14.

Richards, F. (1959). A flexible growth function for empirical use, *Journal of Experimental Botany*, 10, 290-301.

`anova.ocm` *Anova method for Continuous Ordinal Fits*

Description

Comparison of continuous ordinal models using likelihood ratio tests.

Usage

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

Arguments

`object`	an object of class `ocm`
`...`	one or more additional `ocm` objects

Details

Likelihood ratio testing of nested models is performed.

Value

The method returns an object of class `anova.ocm` and `data.frame`, reporting for each model, in hierarchical order:

`no.par`	number of parameters
`AIC`	Akaike information criterion
`loglik`	log-likelihood
`LR.stat`	likelihood ratio statistic
`df`	difference in the degrees of freedom in the models being compared
`Pr(>Chisq)`	p-value from the likelihood ratio test

Author(s)

Maurizio Manuguerra, Gillian Heller

See Also

ocm, print.anova.ocm

Examples

```
ANZ0001.ocm <- ANZ0001[ANZ0001$cycleno==0 | ANZ0001$cycleno==5,]
ANZ0001.ocm$cycleno[ANZ0001.ocm$cycleno==5] <- 1
fit.overall  <- ocm(overall  ~ cycleno + bsa + treatment, data=ANZ0001.ocm)
anova(fit.overall, update(fit.overall, .~. + age))
```

---

anova.ocmm *Anova method for Continuous Ordinal Mixed Model Fits*

Description

Comparison of continuous ordinal mixed models using likelihood ratio tests

Usage

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

Arguments

object	an ocmm object
...	one or more additional ocmm objects

Value

An object of class anova.ocmm and data.frame, reporting for each model, in hierarchical order:

no.par	number of parameters
AIC	Akaike information criterion
loglik	log-likelihood
LR.stat	likelihood ratio statistic
df	difference in the degrees of freedom in the models being compared
Pr(>Chisq)	p-value from the likelihood ratio test

Author(s)

Maurizio Manuguerra, Gillian Heller

Examples

```
## Not run:
fit.overall.rnd  <- ocmm(overall  ~ cycleno + bsa + treatment + (1|randno), data=ANZ0001)
anova(fit.overall.rnd, update(fit.overall.rnd, .~. + age))

## End(Not run)
```

ANZ0001 *ANZ0001 trial*

Description

ANZ0001 trial

Usage

```
data(ANZ0001)
```

Format

A data frame with 2473 rows and 11 variables

Details

The ANZ0001 trial, conducted by the ANZ Breast Cancer Trials Group, is an unblinded, multicentre, randomized trial with three chemotherapy treatment arms, concluded in 2005 (Stockler et al 2007). Health-related quality of life measures (Overall quality of life, Physical Well-Being, Mood, Pain, Nausea and Vomiting, Appetite) are assessed at each chemotherapy treatment cycle, from randomization until disease progression, when treatment is interrupted. The treatments Intermittent Capecitabine (IC) and Continuous Capecitabine (CC) are compared with the standard combination treatment CMF, each with its own protocol. There is no maximum duration of treatment, but it is interrupted on disease progression, or when patient intolerance or unacceptable toxicity are recorded. The data set is extracted from the ANZ0001 trial and contains information from 292 patients with complete quality of life measurements.

The variables are as follows:

`randno`	patient ID number
`cycleno`	chemotherapy cycle number
`age`	age of patient at entry to study
`bsa`	Body Surface Area (m^2)
`treatment`	treatment received by patient (1,2,3)
`overall`	Overall quality of life as recorded by the patient on a LASA scale, normalized to (0, 1)
`phys`	Physical Well-Being as recorded by the patient on a LASA scale, normalized to (0, 1)
`mood`	Mood as recorded by the patient on a LASA scale, normalized to (0, 1)
`pain`	Pain as recorded by the patient on a LASA scale, normalized to (0, 1)
`nausvom`	Nausea and Vomiting as recorded by the patient on a LASA scale, normalized to (0, 1)
`appetite`	Appetite as recorded by the patient on a LASA scale, normalized to (0, 1)

References

Stockler, M., T. Sourjina, P. Grimison, V. Gebski, M. Byrne, V. Harvey, P. Francis et al. "A randomized trial of capecitabine (C) given intermittently (IC) rather than continuously (CC) compared to classical CMF as first-line chemotherapy for advanced breast cancer (ABC)." In *ASCO Annual Meeting Proceedings*, vol. 25, no. 18_suppl, p. 1031. 2007.

dg_glf *Derivative of generalized logistic g function*

Description

Derivative of the generalized logistic function as in Richards (1959):

$$g'(v) = \frac{T}{B}\frac{1}{v(1-v^T)}$$

Usage

```
dg_glf(v, par)
```

Arguments

v	vector of standardized scores from the continuous ordinal scale, 0<v<1.
par	vector of 2 elements: B, the slope of the curve, and T, the symmetry of the curve.

Value

A vector of length equal to the length of v, with values $g'(v)$.

Author(s)

Maurizio Manuguerra, Gillian Heller

References

Richards, F. (1959). A flexible growth function for empirical use, *Journal of Experimental Botany*, 10, 290-301.

See Also

g_glf,g_glf_inv

`extractAIC.ocm` *Extract AIC from a fitted Continuous Ordinal Model*

Description

Extracts the AIC for a fitted `ocm` object

Usage

```
## S3 method for class 'ocm'
extractAIC(fit, scale = 0, k = 2, ...)
```

Arguments

`fit`	`ocm` object
`scale`	parameter currently not used. For compatibility with general extractAIC method.
`k`	"weight" of the equivalent degrees of freedom (=: edf) in the AIC formula. Defaults to 2
`...`	further arguments to be passed to methods

Details

The generalized AIC is computed:

$$-2\ell + k \cdot edf$$

where ℓ is the log likelihood, k=2 gives the AIC, and k=log(n) gives the BIC.

Value

A numeric vector of length 2, with first and second elements giving

`edf`	the "equivalent degrees of freedom" for the fitted model `fit`
`AIC`	the generalized AIC of `ocm` object `fit`

Author(s)

Maurizio Manuguerra, Gillian Heller

References

Akaike, H (1983). Information measures and model selection, *Bulletin of the International Statistical Institute*, 50:277-290.

See Also

`ocm`, `extractAIC.ocmm`

Examples

```
ANZ0001.ocm <- ANZ0001[ANZ0001$cycleno==0 | ANZ0001$cycleno==5,]
ANZ0001.ocm$cycleno[ANZ0001.ocm$cycleno==5] <- 1
fit.overall  <- ocm(overall  ~ cycleno + age + bsa + treatment, data=ANZ0001.ocm)
extractAIC(fit.overall)
```

`extractAIC.ocmm` *Extract AIC from a fitted Continuous Ordinal Mixed Model*

Description

Extracts the AIC for a fitted `ocmm` object

Usage

```
## S3 method for class 'ocmm'
extractAIC(fit, scale = 0, k = 2, ...)
```

Arguments

`fit`	`ocmm` object
`scale`	parameter currently not used. For compatibility with general extractAIC method.
`k`	'weight' of the equivalent degrees of freedom (=: edf) in the AIC formula. Defaults to 2.
`...`	further arguments (currently unused)

Details

The generalized AIC is computed:

$$-2\ell + k \cdot edf$$

where ℓ is the log likelihood, k=2 gives the AIC, and k=log(n) gives the BIC.

Value

A numeric vector of length 2, with first and second elements giving

`edf`	the "equivalent degrees of freedom" for the fitted model `fit`
`AIC`	the generalized AIC of `ocmm` object `fit`

Author(s)

Maurizio Manuguerra, Gillian Heller

References

Akaike, H (1983). Information measures and model selection, *Bulletin of the International Statistical Institute*, 50:277-290.

See Also

ocmm, extractAIC.ocm

Examples

```
## Not run:
fit.overall.rnd  <- ocmm(overall  ~ cycleno + age + bsa + treatment + (1|randno), data=ANZ0001)
extractAIC(fit.overall.rnd)

## End(Not run)
```

---

g_glf *Generalized logistic g function*

Description

A parametric version of the g function following Richards (1959):

$$g(v) = M + \frac{1}{B} \log\left(\frac{Tv^T}{1 - v^T}\right)$$

Usage

```
g_glf(v, par)
```

Arguments

v	vector of standardized scores from the continuous ordinal scale, 0<v<1
par	vector of 3 elements: M, the offset, B, the slope of the curve, and T, the symmetry of the curve

Details

The generalized logistic functions maps from (0,1) to $(-\infty, \infty)$. B is the slope of the curve, T is the symmetry and M is the offset.

Value

A vector of length equal to the length of v, with values $g(v)$.

Author(s)

Maurizio Manuguerra, Gillian Heller

References

Richards, F. (1959). A flexible growth function for empirical use, *Journal of Experimental Botany*, 10, 290-301.

See Also

dg_glf, g_glf_inv

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g_glf_inv *Inverse of generalized logistic g function*

Description

Inverse of a parametric version of the g function following Richards (1959):

$$g^{-1}(W) = \left(\frac{e^{B(W-M)}}{T + e^{B(W-M)}} \right)^{\frac{1}{T}}$$

Usage

```
g_glf_inv(W, par)
```

Arguments

W	vector of scores on the latent scale $(-\infty, \infty)$
par	vector of 3 elements: M, the offset of the curve, B, the slope of the curve, and T, the symmetry of the curve

Value

A vector of length equal to the length of W, with values $g^{-1}(W)$

Author(s)

Maurizio Manuguerra, Gillian Heller

References

Richards, F. (1959). A flexible growth function for empirical use, *Journal of Experimental Botany*, 10, 290-301.

See Also

g_glf,dg_glf

logLik.ocm *Extract Log-likelihood for a Continuous Ordinal Model*

Description

Extracts the log-likelihood for a fitted ocm object

Usage

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

Arguments

object	an ocm object
...	further arguments to be passed to methods

Value

The log-likelihood of an ocm object. This is a number with attributes

df	estimated degrees of freedom for the fitted model object
nobs	number of observations used in the fitted model object
class	class of the returned object: logLik.ocm

Author(s)

Maurizio Manuguerra, Gillian Heller

See Also

ocm

Examples

```
ANZ0001.ocm <- ANZ0001[ANZ0001$cycleno==0 | ANZ0001$cycleno==5,]
ANZ0001.ocm$cycleno[ANZ0001.ocm$cycleno==5] <- 1
fit.overall  <- ocm(overall  ~ cycleno + age + bsa + treatment, data=ANZ0001.ocm)
logLik(fit.overall)
```

`logLik.ocmm` *Extract Log-likelihood for a Continuous Ordinal Mixed Model*

Description

Extracts the log-likelihood for a fitted `ocmm` object

Usage

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

Arguments

`object`	an `ocmm` object
`...`	further arguments to be passed to methods

Value

The log-likelihood of an `ocmm` object. This is a number with attributes

`df`	estimated degrees of freedom for the fitted model `object`
`nobs`	number of observations used in the fitted model `object`
`class`	class of the returned object: `logLik.ocmm`

Author(s)

Maurizio Manuguerra, Gillian Heller

See Also

`ocmm`

Examples

```
## Not run:
fit.overall.rnd  <- ocmm(overall  ~ cycleno + age + bsa + treatment + (1|randno), data=ANZ0001)
logLik(fit.overall.rnd)

## End(Not run)
```

negloglik_glf *Log-likelihood function for the fixed-effects model*

Description

Log-likelihood function for the fixed-effects model

Usage

```
negloglik_glf(par, v, d.matrix, wts, len_beta)
```

Arguments

par	vector of regression coefficients, and M, B, T, (offset, slope and symmetry of the g function)
v	vector of standardized scores from the continuous ordinal scale
d.matrix	design matrix (fixed effects)
wts	optional case weights
len_beta	length of the regression coefficients vector

Details

This function computes minus the log-likelihood function for a fixed-effects model using the generalized logistic function as g function and the logit link function. It is used internally to fit the model and should not be of interest of the user.

Value

Minus the log-likelihood at parameter values par

Author(s)

Maurizio Manuguerra, Gillian Heller

negloglik_glf_rnd *Log-likelihood function for the mixed-effects model*

Description

Log-likelihood function for the mixed-effects continuous ordinal model, using the generalized logistic function as g function and the logit link function

Usage

```
negloglik_glf_rnd(par, v, d.matrix, rnd.matrix, wts, len_beta, rnd, n_nodes,
  quad, iclusters)
```

Arguments

par	vector of regression coefficients, M, B, T, (offset, slope and symmetry of the g function) and the standard deviation of the random effect
v	vector of standardized scores from the continuous ordinal scale
d.matrix	design matrix (fixed effects)
rnd.matrix	random term model matrix
wts	optional case weights
len_beta	length of the regression coefficients vector
rnd	character vector listing the random terms
n_nodes	order of Gauss-Hermite rule used (number of nodes)
quad	string indicating the type of quadrature used to integrate over the random effects. Can take values "Laplace" (Adaptive Gauss-Hermite quadrature using Laplace approximation; the default) or "GH" (Gauss-Hermite quadrature).
iclusters	list containing the row numbers of the design matrix relative to each level of the factor over which random effects are computed

Details

This function computes minus the log-likelihood function for a mixed-effects model using the generalized logistic function as g function and the logit link function. It is used internally to fit the model and should not be of interest of the user.

Value

Minus the log-likelihood at parameter values par

Author(s)

Maurizio Manuguerra, Gillian Heller

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ocm *Ordinal regression for continuous scales*

Description

Continuous ordinal regression with logit link using the generalized logistic function as g function.

Usage

```
ocm(formula, data = NULL, weights, start = NULL, link = c("logit"),
  gfun = c("glf"), method = c("optim", "ucminf"))
```

Arguments

formula	a formula expression as for regression models, of the form response ~ predictors. Only fixed effects are supported. The model must have an intercept: attempts to remove one will lead to a warning and will be ignored.
data	an optional data frame in which to interpret the variables occurring in the formulas
weights	optional case weights in fitting. Defaults to 1.
start	a vector of initial values for the regression coefficients and M, B, T, (offset, slope and symmetry of the g function)
link	link function, i.e. the type of location-scale distribution assumed for the latent distribution. The default "logit" link gives the proportional odds model and is the only link function currently supported.
gfun	A smooth monotonic function capable of capturing the non-linear nature of the ordinal measure. It defaults to the generalized logistic function, which is currently the only possibility.
method	The optimizer used to maximize the likelihood function.

Details

Fits a continuous ordinal regression model, with fixed effects. The g function is the generalized logistic function (see g_glf), and the link function is the logit, implying the standard logistic distribution for the latent variable. Maximum likelihood estimation is performed, using optim {stats} with a quasi-Newton method ("BFGS"). For continuous ordinal mixed modelling, see ocmm.

Value

an object of type ocm with the components listed below. Parameter estimates are in coefficients. The last 3 elements of coefficients are the parameters of the g function: M, B, and T.

coefficients	parameter estimates
vcov	variance-covariance matrix
df	estimated degrees of freedom
logLik	value of the log-likelihood at the estimated optimum
len_beta	number of fixed-effects parameters of the model
len_gfun	number of parameters in the g function used in the model
fitted.values	fitted probabilities
residuals	residuals on the latent scale
v	vector of continuous scores
x	model matrix
sample.size	sample size (can differ from the number of observations if the weights are different from 1)
nobs	number of observations
call	call to fit the model

no.pars	total number of parameters estimated
data	data frame used
link	link function used
gfun	g function used
formula	formula used

Author(s)

Maurizio Manuguerra, Gillian Heller

References

Manuguerra M, Heller GZ (2010). Ordinal Regression Models for Continuous Scales, *The International Journal of Biostatistics*: 6(1), Article 14.

See Also

For continuous ordinal mixed models, see ocmm

Examples

```
ANZ0001.ocm <- ANZ0001[ANZ0001$cycleno==0 | ANZ0001$cycleno==5,]
ANZ0001.ocm$cycleno[ANZ0001.ocm$cycleno==5] <- 1
fit.overall  <- ocm(overall  ~ cycleno + age + bsa + treatment, data=ANZ0001.ocm)
fit.phys    <- ocm(phys    ~ cycleno + age + bsa + treatment, data=ANZ0001.ocm)
fit.pain    <- ocm(pain    ~ cycleno + age + bsa + treatment, data=ANZ0001.ocm)
fit.mood    <- ocm(mood    ~ cycleno + age + bsa + treatment, data=ANZ0001.ocm)
fit.nausvom  <- ocm(nausvom  ~ cycleno + age + bsa + treatment, data=ANZ0001.ocm)
fit.appetite <- ocm(appetite ~ cycleno + age + bsa + treatment, data=ANZ0001.ocm)
summary(fit.overall)
summary(fit.phys)
summary(fit.pain)
summary(fit.mood)
summary(fit.nausvom)
summary(fit.appetite)
par(mfrow=c(2,3))
plot(fit.overall, CIs='vcov', R=100)
plot(fit.phys, CIs='vcov', R=100)
plot(fit.pain, CIs='vcov', R=100)
plot(fit.mood, CIs='vcov', R=100)
plot(fit.nausvom, CIs='vcov', R=100)
plot(fit.appetite, CIs='vcov', R=100)
par(mfrow=c(1,1))
```

ocmm *Ordinal regression for continuous scales with mixed effects*

Description

Fits an ordinal continuous mixed model with logit link, using the generalized logistic function as g function.

Usage

```
ocmm(formula, data = NULL, weights, start = NULL, link = c("logit"),
  gfun = c("glf"), method = c("optim", "ucminf"), quad = c("Laplace",
  "GH"), n_nodes = 10)
```

Arguments

formula	a formula expression as for regression models, of the form response ~ predictors. Only mixed-effects models with a single random effect on the intercept are supported. The model must have an intercept: attempts to remove one will lead to a warning and will be ignored.
data	an optional data frame in which to interpret the variables occurring in the formulas
weights	optional case weights in fitting. Defaults to 1.
start	a vector of initial values for the regression coefficients, M, B, T, (offset, slope and symmetry of the g function) and the standard deviation of the random effect
link	link function, i.e., the type of location-scale distribution assumed for the latent distribution. The default logit link gives the proportional odds model and is the only link function currently supported.
gfun	A smooth monotonic function capable of capturing the non-linear nature of the ordinal measure. It defaults to the generalized logistic function (g_glf), which is currently the only possibility.
method	The optimizer used to maximize the likelihood function.
quad	A string indicating the type of quadrature used to integrate over the random effects. Can take values "Laplace" (Adaptive Gauss-Hermite quadrature using Laplace approximation; the default) or "GH" (Gauss-Hermite quadrature).
n_nodes	order of Gauss-Hermite rule used (number of nodes)

Details

Fits a continuous ordinal regression model, with fixed and random effects. The g function is the generalized logistic function (see g_glf), and the link function is the logit, implying the standard logistic distribution for the latent variable. Maximum likelihood estimation is performed, using optim {stats} with a quasi-Newton method ("BFGS"). Either adaptive Gauss-Hermite quadrature with the Laplace approximation, or Gauss-Hermite quadrature, is used. For continuous ordinal modelling with fixed effects only, see ocm.

Value

An object of type ocmm with the components listed below.

coefficients	parameter estimates. The first len_beta elements are the estimates of the fixed-effects parameters; the last 4 elements are the estimates of the parameters of the g function (M, B, and T) and the standard deviation of the random effect.
vcov	variance-covariance matrix, of dimension (len_beta +4)x(len_beta +4)
sigma_rnd	standard deviation of the random effect
df	estimated degrees of freedom
logLik	value of the log-likelihood at the estimated optimum
len_beta	number of fixed-effects parameters of the model
len_gfun	number of parameters in the g function used in the model
len_rnd	number of random effects (1 in this version of the package)
fitted.values	fitted probabilities
residuals	residuals on the latent scale
v	vector of continuous scores
x	model matrix
sample.size	sample size (can differ from the number of observations if the weights are different from 1)
nobs	number of observations
call	call to fit the model
no.pars	total number of parameters estimated
data	data frame used
link	link function used
gfun	g function used
formula	formula used

Author(s)

Maurizio Manuguerra, Gillian Heller

Examples

```
## Not run:
fit.overall.rnd  <- ocmm(overall  ~ cycleno + age + bsa + treatment + (1|randno), data=ANZ0001)
fit.phys.rnd    <- ocmm(phys     ~ cycleno + age + bsa + treatment + (1|randno), data=ANZ0001)
fit.pain.rnd    <- ocmm(pain     ~ cycleno + age + bsa + treatment + (1|randno), data=ANZ0001)
fit.mood.rnd    <- ocmm(mood     ~ cycleno + age + bsa + treatment + (1|randno), data=ANZ0001)
fit.nausvom.rnd <- ocmm(nausvom ~ cycleno + age + bsa + treatment + (1|randno), data=ANZ0001)
fit.appetite.rnd <- ocmm(appetite ~ cycleno + age + bsa + treatment + (1|randno), data=ANZ0001)
summary(fit.overall.rnd)
summary(fit.phys.rnd)
summary(fit.pain.rnd)
summary(fit.mood.rnd)
```

```
summary(fit.nausvom.rnd)
summary(fit.appetite.rnd)

## End(Not run)
```

---

plot.ocm *Plot method for Continuous Ordinal Fits*

Description

Plots the g function as fitted in an ocm call.

Usage

```
## S3 method for class 'ocm'
plot(x, CIs = c("no", "vcov", "rnd.x.bootstrap",
  "fix.x.bootstrap", "param.bootstrap"), R = 1000,
  main = "g function (95% CIs)", xlab = "Continuous ordinal scale",
  ylab = "", CIcol = "lightblue", ...)
```

Arguments

x	an object of class ocm
CIs	method used for confidence bands for the g function. "no" = no CIS [default]; "vcov" = Wald; "rnd.x.bootstrap" = random-x bootstrap; "fix.x.bootstrap" = bootstrap with fixed-x resampling; "param.bootstrap" = parametric bootstrap
R	the number of bootstrap replicates. Ignored if CIs="no"
main	title of the plot. Defauts to "g function (95% CIs)"
xlab	label of the x axis. Defaults to "Continuous ordinal scale"
ylab	label of the y axis. Defaults to an emtpy string
CIcol	color of the confidence interval bands. Defaults to "lightblue"
...	further arguments passed to or from other methods

Details

The fitted g function of an ocm object is plotted. If CIs is not "no", 95% confidence bands are also plotted. Confidence bands computed with any of the bootstrapping options are obtained with simple percentiles.

Author(s)

Maurizio Manuguerra, Gillian Heller

See Also

ocm

Examples

```
ANZ0001.ocm <- ANZ0001[ANZ0001$cycleno==0 | ANZ0001$cycleno==5,]
ANZ0001.ocm$cycleno[ANZ0001.ocm$cycleno==5] <- 1
fit.overall  <- ocm(overall  ~ cycleno + age + bsa + treatment, data=ANZ0001.ocm)
plot(fit.overall, CIs="vcov")
## Not run:
plot(fit.overall, CIs="rnd.x.bootstrap", R=100)
plot(fit.overall, CIs="fix.x.bootstrap", R=100)
plot(fit.overall, CIs="param.bootstrap", R=100)

## End(Not run)
```

`plot.ocmm` *Plot method for Continuous Ordinal Mixed Model Fits*

Description

Plots the g function as fitted in an `ocmm` call.

Usage

```
## S3 method for class 'ocmm'
plot(x, CIs = c("no", "vcov"), R = 1000,
  main = "g function (95% CIs)", xlab = "Continuous ordinal scale",
  ylab = "", CIcol = "lightblue", ...)
```

Arguments

`x`	an `ocmm` object
`CIs`	indicates if confidence bands for the g function should be computed (based on the Wald 95% CIs). `"no"` = no CIS [default]; `"vcov"` = Wald
`R`	number of bootstrap replicates
`main`	title of the plot. Defauts to "g function (95% CIs)"
`xlab`	label of the `x` axis. Defaults to "Continuous ordinal scale"
`ylab`	label of the `y` axis. Defaults to an emtpy string
`CIcol`	color of the confidence interval bands. Defaults to "lightblue"
`...`	further arguments passed to or from other methods

Details

The fitted g function of an `ocmm` object is plotted.

Author(s)

Maurizio Manuguerra, Gillian Heller

See Also

plot.ocm, ocmm

Examples

```
## Not run:
fit.overall.rnd  <- ocmm(overall  ~ cycleno + age + bsa + treatment + (1|randno), data=ANZ0001)
plot(fit.overall.rnd, CIs="vcov", R=100)

## End(Not run)
```

---

plot.predict.ocm *Plot probability densities from output of predict method*

Description

Plot method for class predict.ocm

Usage

```
## S3 method for class 'predict.ocm'
plot(x, records = NULL, ...)
```

Arguments

x	An object of class predict.ocm
records	An integer or a vector of integers. The number of the record/s in the data set for which the density has to be plotted. If not specified, the function will plot all records.
...	further arguments passed to or from other methods

Details

The probability densities from predict.ocm are plotted.

Author(s)

Maurizio Manuguerra, Gillian Heller

See Also

predict.ocm, ocm

Examples

```
ANZ0001.ocm <- ANZ0001[ANZ0001$cycleno==0 | ANZ0001$cycleno==5,]
ANZ0001.ocm$cycleno[ANZ0001.ocm$cycleno==5] <- 1
fit.overall <- ocm(overall ~ cycleno + age + bsa + treatment, data=ANZ0001.ocm)
pred <- predict(fit.overall)
plot(pred)
```

`predict.ocm` *Predict method for Continuous Ordinal Fits*

Description

Predicted values based on `ocm` object

Usage

```
## S3 method for class 'ocm'
predict(object, newdata = NULL, ndens = 100, ...)
```

Arguments

`object`	an object of class `ocm`, usually a result of a call to `ocm`
`newdata`	optionally, a data frame in which to look for variables with which to predict. Note that all predictor variables should be present, having the same names as the variables used to fit the model. If `NULL`, predictions are computed for the original dataset.
`ndens`	the number of points on the continuous ordinal scale (0, 1) over which the densities are computed. The default is 100.
`...`	further arguments passed to or from other methods

Details

An object of class `ocm` and optionally a new data frame are used to compute the probability densities of `v`, the continuous ordinal score. The estimated parameters of the fitted model and `ndens` (default: 100) values of `v` are used to compute the probability densities on the latent scale. These values are then transformed to scores on the continuous ordinal scale using the `g` function and the estimated values of `M`, `B`, and `T`.

Value

A list containing the following components:

`mode`	a vector of length equal to the number of observations. Each element is the mode of `v`, the continuous ordinal random variable, conditional on the covariates in the model.

density	a matrix with number of rows equal to the number of observations. Each row contains the values of the density function of v conditional on the covariates in the model. The density function is calculated over ndens equally-spaced values of v in (0,1).
x	a vector with the ndens equally-spaced values of v in (0,1) used to compute the density of v
formula	the formula used to fit the model
newdata	a new data frame used to make predictions. It takes value NULL if no new data frame has been used.

Author(s)

Maurizio Manuguerra, Gillian Heller

See Also

ocm, plot.predict.ocm

Examples

```
ANZ0001.ocm <- ANZ0001[ANZ0001$cycleno==0 | ANZ0001$cycleno==5,]
ANZ0001.ocm$cycleno[ANZ0001.ocm$cycleno==5] <- 1
fit.overall <- ocm(overall ~ cycleno + age + bsa + treatment, data=ANZ0001.ocm)
pred <- predict(fit.overall)
plot(pred)
```

---

print.anova.ocm *Print anova.ocm objects*

Description

Print the results of the comparison of continuous ordinal models in likelihood ratio tests.

Usage

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

Arguments

x	an object of class anova.ocm
digits	controls the number of digits to print. Defaults to the maximum of the value returned by (getOption("digits") - 2) and 3
signif.stars	a logical. Should the significance stars be printed? Defaults to the value returned by getOption("show.signif.stars")
...	further arguments passed to or from other methods

Value

Prints anova.ocm object

Author(s)

Maurizio Manuguerra, Gillian Heller

See Also

ocm, anova.ocm

Examples

```
ANZ0001.ocm <- ANZ0001[ANZ0001$cycleno==0 | ANZ0001$cycleno==5,]
ANZ0001.ocm$cycleno[ANZ0001.ocm$cycleno==5] <- 1
fit.overall  <- ocm(overall  ~ cycleno + bsa + treatment, data=ANZ0001.ocm)
anova(fit.overall, update(fit.overall, .~. + age))
```

---

print.anova.ocmm *Print anova.ocmm objects*

Description

Print the results of the comparison of continuous ordinal mixed models in likelihood ratio tests.

Usage

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

Arguments

x	an object of class anova.ocmm
digits	controls the number of digits to print. Defaults to the maximum of the value returned by (getOption("digits") - 2) and 3
signif.stars	a logical. Should the significance stars be printed? Defaults to the value returned by getOption("show.signif.stars")
...	further arguments passed to or from other methods

Value

Prints anova.ocmm object

Author(s)

Maurizio Manuguerra, Gillian Heller

Examples

```
## Not run:
fit.overall.rnd  <- ocmm(overall  ~ cycleno + bsa + treatment + (1|randno), data=ANZ0001)
anova(fit.overall.rnd, update(fit.overall.rnd, .~. + age))

## End(Not run)
```

`print.ocm` *Print continuous ordinal regression objects*

Description

`print.ocm` is the ordinalCont specific method for the generic function `print`, which prints objects of class `ocm`.

Usage

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

Arguments

`x`	an object of class `ocm`, usually, a result of a call to `ocm`
`...`	further arguments passed to or from other methods

Value

Prints an `ocm` object

Author(s)

Maurizio Manuguerra, Gillian Heller

See Also

`ocm`, `summary.ocm`

Examples

```
ANZ0001.ocm <- ANZ0001[ANZ0001$cycleno==0 | ANZ0001$cycleno==5,]
ANZ0001.ocm$cycleno[ANZ0001.ocm$cycleno==5] <- 1
fit.overall  <- ocm(overall  ~ cycleno + age + bsa + treatment, data=ANZ0001.ocm)
print(fit.overall)
```

`print.ocmm` *Print a Continuous Ordinal Mixed Model Object*

Description

This function prints an `ocmm` object

Usage

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

Arguments

`x`	an object of class `ocmm`, usually, a result of a call to `ocmm`
`...`	further arguments passed to or from other methods

Value

Prints an `ocmm` object

Author(s)

Maurizio Manuguerra, Gillian Heller

See Also

`ocmm`, `summary.ocmm`

Examples

```
## Not run:
fit.overall.rnd  <- ocmm(overall  ~ cycleno + age + bsa + treatment + (1|randno), data=ANZ0001)
print(fit.overall.rnd)

## End(Not run)
```

`print.predict.ocm` *Print the output of predict method*

Description

Print method for class `predict.ocm`

Usage

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

Arguments

`x`	an object of class `predict.ocm`
`...`	further arguments passed to or from other methods

Details

The table of predictions from `predict.ocm` is printed.

Author(s)

Maurizio Manuguerra, Gillian Heller

See Also

`predict.ocm`, `ocm`

Examples

```
ANZ0001.ocm <- ANZ0001[ANZ0001$cycleno==0 | ANZ0001$cycleno==5,]
ANZ0001.ocm$cycleno[ANZ0001.ocm$cycleno==5] <- 1
fit.overall <- ocm(overall ~ cycleno + age + bsa + treatment, data=ANZ0001.ocm)
pred <- predict(fit.overall)
print(pred)
```

summary.ocm *Summarizing Continuous Ordinal Fits*

Description

Summary method for class ocm

Usage

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

Arguments

object	an object of class ocm, usually a result of a call to ocm
...	further arguments passed to or from other methods

Author(s)

Maurizio Manuguerra, Gillian Heller

See Also

ocm, print.ocm

Examples

```
ANZ0001.ocm <- ANZ0001[ANZ0001$cycleno==0 | ANZ0001$cycleno==5,]
ANZ0001.ocm$cycleno[ANZ0001.ocm$cycleno==5] <- 1
fit.overall  <- ocm(overall  ~ cycleno + age + bsa + treatment, data=ANZ0001.ocm)
summary(fit.overall)
```

summary.ocmm *Summarizing Continuous Ordinal Mixed Model Fits*

Description

Summary method for class ocmm

Usage

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

Arguments

object	an object of class ocmm, usually a result of a call to ocmm
...	further arguments passed to or from other methods

Author(s)

Maurizio Manuguerra, Gillian Heller

Examples

```
## Not run:
fit.overall.rnd  <- ocmm(overall  ~ cycleno + age + bsa + treatment + (1|randno), data=ANZ0001)
summary(fit.overall.rnd)

## End(Not run)
```

---

vcov.ocm *Variance-Covariance Matrix for a Fitted Model Object*

Description

Calculates variance-covariance matrix for a fitted ocm object

Usage

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

Arguments

object	an ocm object
...	further arguments to be passed to methods

Details

For the generalized logistic g-function, the variance-covariance matrix of model parameters is of dimension (len_beta +3)x(len_beta +3), where len_beta is the number of beta coefficients in the model.

Value

Variance-covariance matrix of model parameters

Author(s)

Maurizio Manuguerra, Gillian Heller

See Also

ocm

Examples

```
ANZ0001.ocm <- ANZ0001[ANZ0001$cycleno==0 | ANZ0001$cycleno==5,]
ANZ0001.ocm$cycleno[ANZ0001.ocm$cycleno==5] <- 1
fit.overall  <- ocm(overall  ~ cycleno + age + bsa + treatment, data=ANZ0001.ocm)
vcov(fit.overall)
```

---

vcov.ocmm *Variance-Covariance Matrix for a Fitted Continuous Ordinal Mixed Model Object*

Description

Calculates variance-covariance matrix for a fitted ocmm object

Usage

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

Arguments

object	an ocmm object
...	further arguments to be passed to methods

Details

For the generalized logistic g-function, the variance-covariance matrix of model parameters is of dimension (len_beta +4)x(len_beta +4), where len_beta is the number of beta coefficients in the model.

Value

Variance-covariance matrix of model parameters

Author(s)

Maurizio Manuguerra, Gillian Heller

See Also

ocmm

Examples

```
## Not run:
fit.overall.rnd  <- ocmm(overall  ~ cycleno + age + bsa + treatment + (1|randno), data=ANZ0001)
vcov(fit.overall.rnd)

## End(Not run)
```

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