Package 'ordinalCont'

December 3, 2020

Title Ordinal Regression Analysis for Continuous Scales

Version 2.0.2

Author Maurizio Manuguerra [aut, cre],
Gillian Heller [aut]

Maintainer Maurizio Manuguerra <maurizio.manuguerra@mq.edu.au>

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 non-linearity. We treat them as ordinal variables, measured on a continuous scale. A function (the g 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. A variety of link functions are currently implemented. Such models are described in Manuguerra et al (2020) <doi:10.18637/jss.v096.i08>.

Depends R (>= 3.3.0), boot, splines, Deriv

License GPL (>= 2)

LazyData true

RoxygenNote 7.1.1

Encoding UTF-8

NeedsCompilation no

Repository CRAN

Date/Publication 2020-12-02 23:10:02 UTC

R topics documented:

`ordinalCont-package` *ordinalCont-package*

Description

Regression analysis of continous ordinal data via cumulative link models and cumulative link mixed models. The package can be used to fit a variety of transformation models.

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 nonlinearity. 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 expressed with monotone increasing I-splines (Ramsey 1988). 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 the `MI` algorithm (Ma, 2010). Fixed- and mixed-effects models are implemented in the function `ocm`.

Author(s)

Maurizio Manuguerra, Gillian Heller

References

Manuguerra M, Heller GZ, Ma J (2017). Semi-parametric Ordinal Regression Models for Continuous Scales, *Proceedings of the 32nd International Workshop on Statistical Modelling*. July 3-7, 2017, Groningen, Netherlands.

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

Heller, GZ, Manuguerra M, Chow R (2016). How to analyze the Visual Analogue Scale: Myths, truths and clinical relevance, *Scandinavian Journal of Pain*, Volume 13, 67 - 75

Ma, J. (2010). Positively Constrained Multiplicative Iterative Algorithm for Maximum Penalized Likelihood Tomographic Reconstruction, *Nuclear Science* 57 (1): 181-92.

Ramsay, J. O. (1988). Monotone regression splines in action. *Statistical science*, 425-441.

Manuguerra M, Heller GZ, Ma J (2020). Continuous Ordinal Regression for Analysis of Visual Analogue Scales: The R Package ordinalCont, *Journal of Statistical Software*. 96(8). doi:10.18637/jss.v096.i08

`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 @seealso `ocm`, `print.anova.ocm`

Examples

```
## Not run:
fit.overall <- ocm(overall ~ cycleno + bsa + treatment, data=ANZ0001.sub, scale=c(0,100))
anova(fit.overall, update(fit.overall, .~. + age))

## End(Not run)
```

`ANZ0001` *ANZ0001 trial*

Description

The complete ANZ0001 trial data set

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, multi-centre, 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.

ANZ0001.sub *ANZ0001 trial subset*

Description

A subset from the ANZ0001 trial data set

Usage

```
data(ANZ0001.sub)
```

Format

A data frame with 428 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 a subset of 292 patients with complete quality of life measurements, limited to cycle numbers 0 and 5.

The variables are as follows:

randno	patient ID number
cycleno	chemotherapy cycle number, either 0 (initial assessment) or 1 (fifth cycle).
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.

---

coef.ocm *Extract Model Coefficients*

Description

coef.ocm is the ordinalCont specific method for the generic function coef, which extracts model coefficients from objects of class ocm.

Usage

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

Arguments

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

Value

A named numeric vector with the coefficients extracted from the model object.

Author(s)

Maurizio Manuguerra, Gillian Heller

`deriv_link` *Function to compute the derivatives of the link function needed by the algorithm*

Description

Function to compute the derivatives of the link function needed by the algorithm

Usage

```
deriv_link(link = c("logit", "probit", "cloglog", "loglog", "cauchit"))
```

Arguments

`link`	One of "logit" (default), "probit", "cloglog", "loglog" or "cauchit".

Value

A list with the link function and the 1st, 2nd and 3rd derivatives with respect to the argument

---

`deviance.ocm` *Extract the deviance from a fitted Continuous Ordinal Model*

Description

Extracts the absolute conditional deviance for a fitted `ocm` object

Usage

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

Arguments

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

Details

The deviance is computed as:

$$-2\ell$$

where ℓ is the conditional penalized log-likelihood.

Value

The value of the deviance extracted from `object`.

Author(s)

Maurizio Manuguerra, Gillian Heller

See Also

`ocm`

Examples

```
## Not run:
fit.overall <- ocm(overall ~ cycleno + age + bsa + treatment, data=ANZ0001.sub, scale=c(0,100))
deviance(fit.overall)

## End(Not run)
```

`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

Examples

```
## Not run:
fit.overall <- ocm(overall ~ cycleno + age + bsa + treatment, data=ANZ0001.sub, scale=c(0,100))
extractAIC(fit.overall)

## End(Not run)
```

---

fitted.ocm *Extract Model Fitted Values*

Description

fitted.ocm is the ordinalCont specific method for the generic function fitted, which computes model fitted from objects of class ocm.

Usage

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

Arguments

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

Details

An object of class ocm is used to compute the probability densities of the continuous ordinal score. The fitted values are the means of such probability density functions. The output is scaled following the original scale of the scores.

Value

Fitted values computed from object.

Author(s)

Maurizio Manuguerra, Gillian Heller

---

formula.ocm *Model Formulae*

Description

formula.ocm is the ordinalCont specific method for the generic function formula, which extracts the model formula from objects of class ocm.

Usage

```
## S3 method for class 'ocm'
formula(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

A symbolic model formula extracted from the model object.

Author(s)

Maurizio Manuguerra, Gillian Heller

get_gfun *Estimated g function for a Fitted Model Object*

Description

Calculates the estimated g function for a fitted ocm object

Usage

```
get_gfun(object, ...)

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

Arguments

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

Value

a dataframe containing four columns: the values of the score v, the estimated g function and the 95%CIs

NULL

Author(s)

Maurizio Manuguerra, Gillian Heller

See Also

ocm

Examples

```
## Not run:
fit.overall <- ocm(overall ~ cycleno + age + bsa + treatment, data=ANZ0001.sub, scale=c(0,100))
get_gfun(fit.overall)

## End(Not run)
```

inv_link *Function to compute inverse link functions*

Description

Function to compute inverse link functions

Usage

```
inv_link(link = c("logit", "probit", "cloglog", "loglog", "cauchit"))
```

Arguments

link	One of "logit" (default), "probit", "cloglog", "loglog" or "cauchit".

Value

A list with the link function and the 1st, 2nd and 3rd derivatives with respect to the argument

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. When the model maximizes the penalized likelihood, i.e. smoothing is involved in the g function or the formula contains random effects, the effective degrees of freedom are returned.
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

```
## Not run:
fit.overall <- ocm(overall ~ cycleno + age + bsa + treatment, data=ANZ0001.sub, scale=c(0,100))
logLik(fit.overall)

## End(Not run)
```

---

model.frame.ocm *Model Frame*

Description

model.frame.ocm is the ordinalCont specific method for the generic function model.frame, which return a data.frame with the variables needed to use formula and any ... arguments.

Usage

```
## S3 method for class 'ocm'
model.frame(formula, data, random.terms = TRUE, ...)
```

Arguments

formula	a model formula
data	a data.frame containing the variables in formula.
random.terms	a logical indicating if random terms have to be included in the terms object. Defaults to TRUE.
...	a mix of further arguments to pass to the default method.

Value

A c("data.frame") with the variables needed to obtain object.

Author(s)

Maurizio Manuguerra, Gillian Heller

model.matrix.ocm *Model Matrix*

Description

model.matrix.ocm is the ordinalCont specific method for the generic function model.matrix, which extracts the model matrix from objects of class ocm.

Usage

```
## S3 method for class 'ocm'
model.matrix(object, random.terms = TRUE, ...)
```

Arguments

object	an object of class ocm, usually, a result of a call to ocm.
random.terms	a logical indicating if random terms have to be included in the terms object. Defaults to TRUE.
...	further arguments passed to or from other methods.

Value

A design (or model) matrix with the variables needed to obtain the object x, e.g., by expanding factors to a set of dummy variables and expanding interactions similarly.

Author(s)

Maurizio Manuguerra, Gillian Heller

neck_pain *Neck pain data set*

Description

A subset from an Australian chronic neck pain study

Usage

```
data(neck_pain)
```

Format

A data frame with 264 rows and 4 variables

Details

A randomized, double-blind, placebo-controlled study of low-level laser therapy (LLLT) in 88 subjects with chronic neck pain was conducted with the aim of determining the efficacy of 300 mW, 830 nm laser in the management of chronic neck pain. Subjects were randomized to receive a course of 14 treatments over 7 weeks with either active or sham laser to tender areas in the neck. The primary outcome measure was change in a 10 cm Visual Analogue Scale (VAS) for pain. Measurements were taken at baseline, at the end of 7 weeks\' treatment and 12 weeks from baseline.

The variables are as follows:

`id`	patient ID number
`vas`	Neck pain as recorded by the patient on a VAS scale, normalized to (0, 1)
`laser`	laser treatment received by patient, either 1 (active) or 2 (placebo)
`time`	the measurement time, either 1 (initial assessment), 2 (after 7 weeks) or 3 (after 12 weeks).

References

Chow RT, Heller GZ, Barnsley L (2006). "The effect of 300 mW, 830 nm laser on chronic neck pain: a double-blind, randomized, placebo-controlled study." Pain, 124(1-2), 201-10. doi:16806710.

`nobs.ocm` *Extract Model Coefficients*

Description

`nobs.ocm` is the ordinalCont specific method for the generic function `nobs`, which returns number of observations from objects of class `ocm`.

Usage

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

Arguments

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

Value

The (numeric) number of observations in the model object.

Author(s)

Maurizio Manuguerra, Gillian Heller

ocm *Ordinal regression for continuous scales*

Description

Continuous ordinal regression with logit link using I-splines to model the g function.

Usage

```
ocm(
  formula,
  data = NULL,
  scale = NULL,
  weights,
  link = c("logit", "probit", "cloglog", "loglog", "cauchit"),
  niters = c(500, 500),
  conv_crit = 0.01,
  n.int.knots = NULL,
  order = 4,
  lambdas = NA
)
```

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
scale	a vector of length 2 with the boundaries of the ordinal scale used. If not specified, the range of the data is used, and a warning is displayed.
weights	optional case weights in fitting. Defaults to 1.
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. Other options are "logit", "probit", "cloglog", "loglog", "cauchit".
niters	a vector of length 2 with the maximimum number of external and internal iterations used in the fitting algorithm. The internal algorithm estimates the parameters of the model conditional on the current values of λs, the smoothing parameters. The external algorithm estimates the values of λs conditional on the current estimates of the parameters of the model. Default is `c(500,500)`
conv_crit	the smoothing parameters λ's convergence criteria for the iterative process. Default is 0.01
n.int.knots	the number of internal knots used to compute the spline bases. The default (NULL) is round((n-1-order)*0.8) if in the interval [8,15], and 8 or 15 otherwise.
order	the order of the spline functions. The default is 4 (cubic splines).

`lambdas` NA (the default) or a vector of length equal to the number of smoothing terms, including the g function and, optionally, the random effect terms and the smooters. If "lambdas" is a vector, each element λ_i can be a number, in which case the corresponding term is penalized using λ_i as smoothing parameter, zero, in which case the corresponding term is unpenalized, or NA, in which case the value of λ_i is estimated maximmizing the marginal posterior function.

Details

Fits a continuous ordinal regression model using penalized maximum likelihood. The model can contain fixed effects and optionally mixed effects and smoothers. The g function is estimated using monotone increasing I-splines, and the link function is the logit, implying the standard logistic distribution for the latent variable. Penalized maximum likelihood estimation is performed using the `MI` algorithm and the splines smoothing parameters are estimated maximizing the marginal posterior (details of the iterative process are printed out during the fit).

Value

an object of type `ocm` with the components listed below. Parameter estimates are in `coefficients`.

`coefficients`	parameter estimates
`pars_obj`	an object of class `ocmpars` carrying the parameter estimates and other properties of the regression terms
`vcov`	variance-covariance matrix
`H`	the Hessian matrix
`logLik`	value of the log-likelihood at the estimated optimum
`penlogLik`	value of the lenalized log-likelihood at the estimated optimum
`v`	vector of continuous scores
`sample.size`	sample size (can differ from the number of observations if the weights are different from 1)
`edf`	estimated degrees of freedom
`df.residual`	the residual degrees of freedom
`nobs`	number of observations
`terms`	model terms
`call`	call to fit the model
`data`	the data frame as in input, ordered by the outcome values
`model.frame`	the model.frame used in the fit
`model.matrix`	the model.matrix used in the fit
`weights`	case weights in fitting
`sorting`	the ordinal score v sorting vector
`link`	link function used
`formula`	formula used
`scale`	the boundaries of the ordinal scale 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.

Manuguerra M, Heller GZ, Ma J (2017). Semi-parametric Ordinal Regression Models for Continuous Scales, *Proceedings of the 32nd International Workshop on Statistical Modelling*. July 3-7, 2017, Groningen, Netherlands.

Manuguerra M, Heller GZ, Ma J (2020). Continuous Ordinal Regression for Analysis of Visual Analogue Scales: The R Package ordinalCont, *Journal of Statistical Software*. 96(8). doi:10.18637/jss.v096.i08

Examples

```
fit.overall <- ocm(overall ~ cycleno + age + bsa + treatment, data=ANZ0001.sub, scale=c(0,100))
summary(fit.overall)
## Not run:
plot(fit.overall)
## Smoothers and complete data set
fit.overall.smooth <- ocm(overall ~ age + treatment : s(cycleno), data=ANZ0001, scale=c(0,100))
summary(fit.overall.smooth)
plot(fit.overall.smooth)

## End(Not run)
```

`plot.ocm` *Plot method for Continuous Ordinal Fits*

Description

Draws several summary and diagnostic plots, including the estimated g function, the estimated density function of the continuous ordinal score for the null model (no covariates), the histogram of the quantile residuals, the normal Q-Q plot and any smoother included in the model.

Usage

```
## S3 method for class 'ocm'
plot(
  x,
  plot.only = NULL,
  CIs = c("vcov", "no", "rnd.x.bootstrap", "fix.x.bootstrap", "param.bootstrap"),
  R = 100,
  main_gfun = "g function",
  main_density = "Density function when X=0",
  xlab = "Continuous ordinal scale [v]",
  CIcol = "lightblue",
```

```
  individual_plots = F,
  ...
)
```

Arguments

x	an object of class ocm
plot.only	either NULL, in which case all plots are displayed, or a value among "gfun", "quant_resid", "QQplot" or "smoother", in which case only the requested plot is displayed.
CIs	method used for confidence bands for the g function. "vcov" = Wald [default]; "no" = no CIS; "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_gfun	title of the g function plot. Defauts to "g function (95% CIs)"
main_density	title of the density function plot. Defauts to "Density function when X=0"
xlab	label of the x axis for the g function and the density plots. Defaults to "Continuous ordinal scale [v]"
CIcol	color of the confidence interval bands. Defaults to "lightblue"
individual_plots	logical. If TRUE, every figure is drawn in a new window. If FALSE (default), the first four figures are drawn in a 2-by-2 array.
...	further arguments passed to or from other methods

Details

The estimated g function, quantile residual histogram and normal Q-Q plot of an ocm object are plotted. If smothers are included in the formula, the user has the option to plot them in the same graph or separately. If CIs is not "no", 95% confidence bands are also plotted.

Author(s)

Maurizio Manuguerra, Gillian Heller

See Also

ocm

Examples

```
fit.overall <- ocm(overall ~ cycleno + age + bsa + treatment, data=ANZ0001.sub, scale=c(0,100))
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)
```

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,
  type = c("response", "density", "CDF", "quantile", "regressor", "exp_regressor",
    "hazard", "cum_hazard", "survival"),
  prob = 1:(K - 1)/K,
  K = 50,
  ...
)
```

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.
type	type of prediction. One of "response" (default), "density", "CDF", "quantile", "regressor", "exp_regressor", "hazard", "cum_hazard" or "survival"
prob	probabilities used to evaluate the quantile function (if type="quantile")
K	number of evenly spaced values of v over which the probability density is evaluated (if type="density" or type="CDF") or number of probabilities at which the quantile function is evaluated (if type="quantile"). The default is 50.
...	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 predictions. The estimated parameters of the fitted model and K values of v are used to compute the conditional probability density and the conditional cumulative distribution. If a new data frame is used to make predictions, the individual (random) effects are set to zero, while they are maintained to the estimated values if newdata is NULL.

Value

A vector of predictions, according to the type.

Author(s)

Maurizio Manuguerra, Gillian Heller

See Also

ocm

Examples

```
## Not run:
fit.overall <- ocm(overall ~ cycleno + age + bsa + treatment, data=ANZ0001.sub, scale=c(0,100))
pred <- predict(fit.overall)

## End(Not run)
```

---

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

---

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

---

summary.ocm *Summarizing Continuous Ordinal Fits*

Description

Summary method for class ocm

Usage

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

Arguments

object	an object of class ocm, usually a result of a call to ocm
full	logical, if TRUE (the default) all the parameters are printed; if FALSE, only the fixed effects are printed.
...	further arguments passed to or from other methods

Author(s)

Maurizio Manuguerra, Gillian Heller

See Also

ocm, print.ocm

Examples

```
fit.overall <- ocm(overall ~ cycleno + age + bsa + treatment, data=ANZ0001.sub, scale=c(0,100))
summary(fit.overall)
```

---

terms.ocm *Model Terms*

Description

terms.ocm is the ordinalCont specific method for the generic function terms, which extracts model terms from objects of class ocm.

Usage

```
## S3 method for class 'ocm'
terms(x, random.terms = TRUE, ...)
```

Arguments

x	an object of class ocm, usually, a result of a call to ocm.
random.terms	a logical indicating if random terms have to be included in the terms object. Defaults to TRUE.
...	further arguments passed to or from other methods.

Value

An object of class c("terms", "formula") which contains the terms representation of a symbolic model.

Author(s)

Maurizio Manuguerra, Gillian Heller

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 includes information on fixed- and random- effect terms and smoothing terms.

Value

Variance-covariance matrix of model parameters

Author(s)

Maurizio Manuguerra, Gillian Heller

See Also

ocm

Examples

```
## Not run:
fit.overall <- ocm(overall ~ cycleno + age + bsa + treatment, data=ANZ0001.sub, scale=c(0,100))
vcov(fit.overall)

## End(Not run)
```

Index