

Package ‘ordDisp’

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Type Package

Title Separating Location and Dispersion in Ordinal Regression Models

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Description Estimate location-shift models or rating-scale models accounting for response styles (RSRS) for the regression analysis of ordinal responses.

Depends VGAM, methods

License GPL-2

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Contents

ordDisp-class	2
plotordDisp	4
reti	6

Index	7
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Description

A function to estimate the location-shift model or rating-scale model accounting for response styles (RSRS) for the regression analysis of ordinal responses. The model allows to account for differing variability in subgroups of the population. The model explicitly links varying dispersion (or response behaviour) to explanatory variables (metric, binary, ordinal and/or nominal). The basic models are described in Tutz and Berger (2016) and Tutz and Berger (2017).

Usage

```
ordDisp(
  formula,
  data,
  family = c("cumulative", "acat"),
  scaling = TRUE,
  middle = TRUE,
  m = NULL,
  n_bs = 6,
  reverse = FALSE,
  ...
)
```

Arguments

formula	Object of class formula : a symbolic description of the model to be fitted. See details.
data	Data.frame of class data.frame containing the variables of the model.
family	Type of link function that is used to link the mean responses to the linear predictors of the model; ordDisp currently allows only one out of "cumulative" and "acat". See details.
scaling	If true, the thresholds of the location-shift model are shifting by using scale values for the widening of the intervals between two thresholds.
middle	If true, the model expects a symmetric response of the form 'strongly disagree', 'moderately disagree', ..., 'moderately agree', 'strongly agree'.
m	Middle category of the (non-symmetric) response, chosen for the model. Only relevant, if middle=FALSE.
n_bs	Number of inner B-spline basis functions for smooth components (see details).
reverse	Argument of the family function passed to vglm .
...	Further arguments passed to or from other methods

Details

The `formula` has to have the form `response ~ x-variables|z-variables`, where `response` is the name of the ordinal response variable, `x-variables` are the terms that specify the location (or content-related) effects of the model and `z-variables` are the terms that specify the dispersion (or response-style) effects.

If all the variables are entered in both parts of the model, the right hand side of the formula can, for example, have the form `x1+...+xp|x1+...+xp`. If the second part is omitted, a simple model without dispersion (or response-style) effects is fitted.

The function allows for smooth (non-linear) effects in the `x-variables` and/or the `z-variables`. Smooth effects are specified by entering `s(x)` and/or `s(z)` into the formula. The functions are fitted using `n_bs` B-spline basis functions.

Function `ordDisp` internally calls `vglm` from package VGAM. Argument `family` is passed to `vglm`. Currently two link functions are implemented

- "cumulative" to estimate a cumulative model of the form

$$P(y \leq r)/P(y > r) = \eta_r$$

- "acat" to estimate a adjacent-categories model of the form

$$P(y = r + 1)/P(y = r) = \eta_r$$

Value

Object of class `ordDisp` which inherits from `vglm`. The object comprises all the slots of an "vglm"-object and in addition the following components:

<code>outercall</code>	The matched call of <code>ordDisp</code> .
<code>X</code>	Design matrix of <code>x-variables</code> .
<code>Z</code>	Design matrix of <code>z-variables</code> .

All the methods implemented for objects of class `vglm`, like `print`, `summary`, `predict` and `plot` can be applied.

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References

- Tutz, Gerhard and Berger, Moritz (2016): Response Styles in Rating Scales - Simultaneous Modelling of Content-Related Effects and the Tendency to Middle or Extreme Categories, *Journal of Educational and Behavioral Statistics* 41(3), 239-268.
- Tutz, Gerhard and Berger, Moritz (2017): Separating Location and Dispersion in Ordinal Regression Models, *Econometrics and Statistics* 2, 131-148.
- Tutz, Gerhard and Berger, Moritz (2022): Sparser Ordinal Regression Models Based on Parametric and Additive Location-Shift Approaches. *International Statistical Review*, 90(2), 306-327.

See Also

[summaryvglm](#), [predictvglm](#), [plotordDisp](#)

Examples

```
data(reti)

mod <- ordDisp(RET~SM+DIAB+GH+BP|SM+DIAB,data=reti,family="cumulative")
summary(mod)

mod2 <- ordDisp(RET~SM+s(DIAB)+GH+BP|SM+DIAB+GH+BP, data=reti,
family="cumulative", n_bs=4, scaling=FALSE)
summary(mod2)
```

plotordDisp

Visualization of Estimated Effects

Description

A function to visualize the estimated effects of the location-shift model or rating-scale model accounting for response styles (RSRS) obtained by `ordDisp`. In case of linear effects, the function returns a two-dimensional plot of the tuple $(exp\alpha, exp\beta)$. It is optional to include pointwise 95% confidence intervals represented by stars, where the horizontal and vertical length correspond to the confidence intervals of $exp\alpha$ (dispersion or response-style effect) and $exp\beta$ (location or content-related effect). In case of smooth effects, the function returns two plots of the fitted (non-linear) functions $f(\beta)$ and $f(\alpha)$.

Usage

```
plotordDisp(
  x,
  names,
  colorvec,
  reference = NULL,
  labels = NULL,
  cex = 1,
  KI = FALSE,
  KIfactor = 10/11,
  title = NULL,
  ...
)
```

Arguments

x	Object of class <code>ordDisp</code>
names	Names of the variables that shall be plotted

colorvec	Vector of colors that are used for plotting (same length as names)
reference	Optional name of reference with estimate $(\alpha, \beta) = (0, 0)$ (for categorical covariates)
labels	Optional names that are used as labels in the plot (same length as names)
cex	Global argument to set the size of all the labels in the plot
KI	If true, pointwise 95% confidence intervals are included in the plot
KIfactor	Ratio that is used to plot the stars that represent confidence intervals (only if KI=TRUE)
title	Optional title that is added to the plot
...	Further arguments passed to or from other methods

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References

Tutz, Gerhard and Berger, Moritz (2016): Response Styles in Rating Scales - Simultaneous Modelling of Content-Related Effects and the Tendency to Middle or Extreme Categories, *Journal of Educational and Behavioral Statistics* 41(3), 239-268.

Tutz, Gerhard and Berger, Moritz (2017): Separating Location and Dispersion in Ordinal Regression Models, *Econometrics and Statistics* 2, 131-148.

Tutz, Gerhard and Berger, Moritz (2022): Sparser Ordinal Regression Models Based on Parametric and Additive Location-Shift Approaches. *International Statistical Review*, 90(2), 306-327.

See Also

[ordDisp](#)

Examples

```
data(reti)

mod <- ordDisp(RET~SM+DIAB+GH+BP|SM+DIAB,data=reti,family="cumulative")
plot(mod,names=c("SM","DIAB"),colorvec=c(1,2))
plotvglm(mod)

mod2 <- ordDisp(RET~SM+s(DIAB)+GH+BP|SM+DIAB+GH+BP, data=reti,
family="cumulative", n_bs=4, scaling=FALSE)
plot(mod2, names=c("DIAB"))
```

`reti`*Example Retinopathy*

Description

The data set contains information about persons with retinopathy. In the 6-year followup study on diabetes and retinopathy status the interesting question is how the retinopathy status is associated with several risk factors.

Usage

```
data(reti)
```

Format

A data frame containing 613 observations on 5 variables:

RET retinopathy status (1:no retinopathy, 2:nonproliferative retinopathy, 3:advanced retinopathy or blind)

SM smoker (1:yes, 0:no)

DIAB diabetes duration in years

GH glycosylated hemoglobin measured in percent

BP diastolic blood pressure in mmHg

References

Bender and Grouven (1998): Using binary logistic regression models for ordinal data with nonproportional odds, *J. Clin. Epidemiol.*, 51, 809-816.

Examples

```
data(reti)
table(reti$RET)
```

Index

`data.frame`, 2

`formula`, 2, 3

`ordDisp`, 4, 5

`ordDisp(ordDisp-class)`, 2

`ordDisp-class`, 2

`plotordDisp`, 4, 4

`predictvglm`, 4

`reti`, 6

`summaryvglm`, 4

`vglm`, 2, 3