# Package 'MultOrdRS'

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**Type** Package

**Title** Model Multivariate Ordinal Responses Including Response Styles

**Version** 0.1-3

**Date** 2024-01-23

**Author** Gunther Schauberger

**Maintainer** Gunther Schauberger <gunther.schauberger@tum.de>

**Description** In the case of multivariate ordinal responses, parameter estimates can be severely bi-ased if personal response styles are ignored. This packages provides methods to account for per-sonal response styles and to explain the effects of covariates on the response style, as pro-posed by Schauberger and Tutz 2021 <doi:10.1177/1471082X20978034>. The method is imple-mented both for the multivariate cumulative model and the multivariate adjacent categories model.

**License** GPL (>= 2)

**Imports** Rcpp (>= 0.12.4), statmod

**LinkingTo** Rcpp, RcppArmadillo

**Encoding** UTF-8

**RoxygenNote** 7.2.3

**NeedsCompilation** yes

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# Contents

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MultOrdRS-package          *Model Multivariate Ordinal Responses Including Response Styles*

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**Description**

A model for multivariate ordinal responses. The response is modelled using a mixed model approach that is also capable of the inclusion of response style effects of the respondents.

**Author(s)**

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https://orcid.org/0000-0002-0392-1580

**References**

Schauberger, Gunther and Tutz, Gerhard (2021): Multivariate Ordinal Random Effects Models Including Subject and Group Specific Response Style Effects, *Statistical Modelling*, doi:10.1177/ 1471082X20978034

**See Also**

multordRS ctrl.multordRS plot.MultOrdRS

**Examples**

```
data(tenseness)

## create a small subset of the data to speed up calculations
set.seed(1860)
tenseness <- tenseness[sample(1:nrow(tenseness), 300),]

## scale all metric variables to get comparable parameter estimates
tenseness$Age <- scale(tenseness$Age)
tenseness$Income <- scale(tenseness$Income)

## two formulas, one without and one with explanatory variables (gender and age)
f.tense0 <- as.formula(paste("cbind(",paste(names(tenseness)[1:4],collapse=","),") ~ 1"))
f.tense1 <- as.formula(paste("cbind(",paste(names(tenseness)[1:4],collapse=","),") ~ Gender + Age"))



####
## Adjacent Categories Models
####

## Multivariate adjacent categories model, without response style, without explanatory variables
m.tense0 <- multordRS(f.tense0, data = tenseness, control = ctrl.multordRS(RS = FALSE, cores = 2))
m.tense0
```

```
## Multivariate adjacent categories model, with response style as a random effect,
## without explanatory variables
m.tense1 <- multordRS(f.tense0, data = tenseness)
m.tense1

## Multivariate adjacent categories model, with response style as a random effect,
## without explanatory variables for response style BUT for location
m.tense2 <- multordRS(f.tense1, data = tenseness, control = ctrl.multordRS(XforRS = FALSE))
m.tense2

## Multivariate adjacent categories model, with response style as a random effect, with
## explanatory variables for location AND response style
m.tense3 <- multordRS(f.tense1, data = tenseness)
m.tense3

plot(m.tense3)



####
## Cumulative Models
####

## Multivariate cumulative model, without response style, without explanatory variables
m.tense0.cumul <- multordRS(f.tense0, data = tenseness, control = ctrl.multordRS(RS = FALSE),
  model = "cumulative")
m.tense0.cumul

## Multivariate cumulative model, with response style as a random effect,
## without explanatory variables
m.tense1.cumul <- multordRS(f.tense0, data = tenseness, model = "cumulative")
m.tense1.cumul

## Multivariate cumulative model, with response style as a random effect,
## without explanatory variables for response style BUT for location
m.tense2.cumul <- multordRS(f.tense1, data = tenseness, control = ctrl.multordRS(XforRS = FALSE),
  model = "cumulative")
m.tense2.cumul

## Multivariate cumulative model, with response style as a random effect, with
## explanatory variables for location AND response style
m.tense3.cumul <- multordRS(f.tense1, data = tenseness, model = "cumulative")
m.tense3.cumul

plot(m.tense3.cumul)

##################################################################
## Examples from Schauberger and Tutz (2020)
## Data from the German Longitudinal Election Study (GLES) 2017
##################################################################
```

```
####
## Source: German Longitudinal Election Study 2017
## Rossteutscher et al. 2017, https://doi.org/10.4232/1.12927
####

## load GLES data
data(GLES17)

## scale data
GLES17[,7:11] <- scale(GLES17[,7:11])

## define formula
f.GLES <- as.formula(cbind(RefugeeCrisis, ClimateChange, Terrorism,
                      Globalization, Turkey, NuclearEnergy) ~
                      Age + Gender + Unemployment + EastWest + Abitur)

## fit adjacent categories model without and with response style parameters
m.GLES0 <- multordRS(f.GLES, data = GLES17, control = ctrl.multordRS(RS = FALSE, cores = 6))
m.GLES <- multordRS(f.GLES, data = GLES17, control =  ctrl.multordRS(cores = 6))

m.GLES0
m.GLES

plot(m.GLES, main = "Adjacent categories model")


## fit cumulative model without and with response style parameters (takes pretty long!!!)
m.GLES20 <- multordRS(f.GLES, data = GLES17,  model="cumul",
control = ctrl.multordRS(opt.method = "nlminb", cores = 6, RS = FALSE))

m.GLES2 <- multordRS(f.GLES, data = GLES17,  model="cumul",
control = ctrl.multordRS(opt.method = "nlminb", cores = 6))

m.GLES20
m.GLES2

plot(m.GLES2, main = "Cumulative model")
```

---

| ctrl.multordRS | *Control Function for multordRS* |
|---|---|

---

**Description**

Control function for multordRS, a model for multivariate ordinal responses including response styles

## Usage

```
ctrl.multordRS(
  RS = TRUE,
  thresholds.acat = c("full", "shift", "minimal"),
  XforRS = TRUE,
  opt.method = c("L-BFGS-B", "nlminb"),
  Q = 10,
  cores = 5,
  lambda = 0.01
)
```

## Arguments

RS
: Logical value indicating whether response style should be modelled.

thresholds.acat

: Type of parametrization used for thresholds: thresholds = "full" implies separate estimates of threshold values for each response variable; thresholds = "shift" implies equal threshold parameter across all response variables modified by shift parameters for each response variable; thresholds = "minimal" implies equal threshold parameter across all response variables. This option only applies for adjacent categories models (model = "acat" and is not implemented for cumulative models.)

XforRS
: Logical value indicating whether also covariate effects on the response style should be considered. Only relevant if RS = TRUE.

opt.method
: Specifies optimization algorithm used by optim, either L-BFGS-B or nlminb.

Q
: Number of nodes to be used (per dimension) in Gauss-Hermite-Quadrature. If RS = TRUE, Gauss-Hermite-Quadrature is two-dimensional.

cores
: Number of cores to be used in parallelized computation.

lambda
: Tuning parameter for internal ridge penalty. It is supposed to be set to a small value to stabilize estimates.

## Value

Returns list of control parameters used in multordRS.

## Author(s)

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<gunther.schauberger@tum.de>
https://orcid.org/0000-0002-0392-1580

## References

Schauberger, Gunther and Tutz, Gerhard (2021): Multivariate Ordinal Random Effects Models Including Subject and Group Specific Response Style Effects, *Statistical Modelling*, doi:10.1177/1471082X20978034

**See Also**

multordRS MultOrdRS-package plot.MultOrdRS

**Examples**

```
data(tenseness)

## create a small subset of the data to speed up calculations
set.seed(1860)
tenseness <- tenseness[sample(1:nrow(tenseness), 300),]

## scale all metric variables to get comparable parameter estimates
tenseness$Age <- scale(tenseness$Age)
tenseness$Income <- scale(tenseness$Income)

## two formulas, one without and one with explanatory variables (gender and age)
f.tense0 <- as.formula(paste("cbind(",paste(names(tenseness)[1:4],collapse=","),") ~ 1"))
f.tense1 <- as.formula(paste("cbind(",paste(names(tenseness)[1:4],collapse=","),") ~ Gender + Age"))



####
## Adjacent Categories Models
####

## Multivariate adjacent categories model, without response style,
## without explanatory variables
m.tense0 <- multordRS(f.tense0, data = tenseness, control = ctrl.multordRS(RS = FALSE))
m.tense0

## Multivariate adjacent categories model, with response style as a random effect,
## without explanatory variables
m.tense1 <- multordRS(f.tense0, data = tenseness)
m.tense1

## Multivariate adjacent categories model, with response style as a random effect,
## without explanatory variables for response style BUT for location
m.tense2 <- multordRS(f.tense1, data = tenseness, control = ctrl.multordRS(XforRS = FALSE))
m.tense2

## Multivariate adjacent categories model, with response style as a random effect, with
## explanatory variables for location AND response style
m.tense3 <- multordRS(f.tense1, data = tenseness)
m.tense3

plot(m.tense3)



####
## Cumulative Models
####
```

```
## Multivariate cumulative model, without response style, without explanatory variables
m.tense0.cumul <- multordRS(f.tense0, data = tenseness,
  control = ctrl.multordRS(RS = FALSE), model = "cumulative")
m.tense0.cumul

## Multivariate cumulative model, with response style as a random effect,
## without explanatory variables
m.tense1.cumul <- multordRS(f.tense0, data = tenseness, model = "cumulative")
m.tense1.cumul

## Multivariate cumulative model, with response style as a random effect,
## without explanatory variables for response style BUT for location
m.tense2.cumul <- multordRS(f.tense1, data = tenseness,
  control = ctrl.multordRS(XforRS = FALSE), model = "cumulative")
m.tense2.cumul

## Multivariate cumulative model, with response style as a random effect, with
## explanatory variables for location AND response style
m.tense3.cumul <- multordRS(f.tense1, data = tenseness, model = "cumulative")
m.tense3.cumul

plot(m.tense3.cumul)

##################################################################
## Examples from Schauberger and Tutz (2020) on
## Data from the German Longitudinal Election Study (GLES) 2017
##################################################################

####
## Source: German Longitudinal Election Study 2017
## Rossteutscher et al. 2017, https://doi.org/10.4232/1.12927
####

## load GLES data
data(GLES17)

## scale data
GLES17[,7:11] <- scale(GLES17[,7:11])

## define formula
f.GLES <- as.formula(cbind(RefugeeCrisis, ClimateChange, Terrorism,
                      Globalization, Turkey, NuclearEnergy) ~
                      Age + Gender + Unemployment + EastWest + Abitur)

## fit adjacent categories model without and with response style parameters
m.GLES0 <- multordRS(f.GLES, data = GLES17, control = ctrl.multordRS(RS = FALSE, cores = 6))
m.GLES <- multordRS(f.GLES, data = GLES17, control =  ctrl.multordRS(cores = 6))

m.GLES0
m.GLES

plot(m.GLES, main = "Adjacent categories model")
```

```
## fit cumulative model without and with response style parameters (takes pretty long!!!)
m.GLES20 <- multordRS(f.GLES, data = GLES17,  model="cumul",
control = ctrl.multordRS(opt.method = "nlminb", cores = 6, RS = FALSE))

m.GLES2 <- multordRS(f.GLES, data = GLES17,  model="cumul",
control = ctrl.multordRS(opt.method = "nlminb", cores = 6))

m.GLES20
m.GLES2

plot(m.GLES2, main = "Cumulative model")
```

---

GLES17                        *German Longitudinal Election Study 2017 (GLES17)*

---

### Description

Data from the German Longitudinal Election Study (GLES) from 2017 (Rossteutscher et al., 2017, https://doi.org/10.4232/1.12927). The GLES is a long-term study of the German electoral process. It collects pre- and post-election data for several federal elections, the data used here originate from the pre-election study for 2017.

### Format

A data frame containing data from the German Longitudinal Election Study with 2036 observations. The data contain socio-demographic information about the participants as well as their responses to items about specific political fears.

**RefugeeCrisis** How afraid are you due to the refugee crisis? (Likert scale from 1 (not afraid at all) to 7 (very afraid))

**ClimateChange** How afraid are you due to the global climate change? (Likert scale from 1 (not afraid at all) to 7 (very afraid))

**Terrorism** How afraid are you due to the international terrorism? (Likert scale from 1 (not afraid at all) to 7 (very afraid))

**Globalization** How afraid are you due to the globalization? (Likert scale from 1 (not afraid at all) to 7 (very afraid))

**Turkey** How afraid are you due to the political developments in Turkey? (Likert scale from 1 (not afraid at all) to 7 (very afraid))

**NuclearEnergy** How afraid are you due to the use of nuclear energy? (Likert scale from 1 (not afraid at all) to 7 (very afraid))

**Age** Age in years

**Gender** 0: male, 1: female

**EastWest** 0: West Germany, 1: East Germany

**Abitur** High School Diploma, 1: Abitur/A levels, 0: else

**Unemployment** 1: currently unemployed, 0: else

## Source

## References

Rossteutscher, S., Schmitt-Beck, R., Schoen, H., Wessels, B., Wolf, C., Bieber, I., Stovsand, L.-C., Dietz, M., and Scherer, P. (2017). Pre-election cross section (GLES 2017). *GESIS Data Archive, Cologne, ZA6800 Data file Version 2.0.0.*, doi:10.4232/1.12927.

Schauberger, Gunther and Tutz, Gerhard (2021): Multivariate Ordinal Random Effects Models Including Subject and Group Specific Response Style Effects, *Statistical Modelling*, doi:10.1177/1471082X20978034

## Examples

```
#################################################################
## Examples from Schauberger and Tutz (2020)
## Data from the German Longitudinal Election Study (GLES) 2017
#################################################################


####
## Source: German Longitudinal Election Study 2017
## Rossteutscher et al. 2017, https://doi.org/10.4232/1.12927
####

## load GLES data
data(GLES17)

## scale data
GLES17[,7:11] <- scale(GLES17[,7:11])

## define formula
f.GLES <- as.formula(cbind(RefugeeCrisis, ClimateChange, Terrorism,
                     Globalization, Turkey, NuclearEnergy) ~
                     Age + Gender + Unemployment + EastWest + Abitur)

## fit adjacent categories model without and with response style parameters
m.GLES0 <- multordRS(f.GLES, data = GLES17, control = ctrl.multordRS(RS = FALSE, cores = 6))
m.GLES <- multordRS(f.GLES, data = GLES17, control =  ctrl.multordRS(cores = 6))

m.GLES0
m.GLES

plot(m.GLES, main = "Adjacent categories model")


## fit cumulative model without and with response style parameters (takes pretty long!!!)
```

```
m.GLES20 <- multordRS(f.GLES, data = GLES17,  model="cumul",
control = ctrl.multordRS(opt.method = "nlminb", cores = 6, RS = FALSE))

m.GLES2 <- multordRS(f.GLES, data = GLES17,  model="cumul",
control = ctrl.multordRS(opt.method = "nlminb", cores = 6))

m.GLES20
m.GLES2

plot(m.GLES2, main = "Cumulative model")
```

---

multordRS                          *Model Multivariate Ordinal Responses Including Response Styles*

---

### Description

A model for multivariate ordinal responses. The response is modelled using a mixed model approach that is also capable of the inclusion of response style effects of the respondents.

### Usage

```
multordRS(
  formula,
  data = NULL,
  control = ctrl.multordRS(),
  se = TRUE,
  model = c("acat", "cumulative")
)
```

### Arguments

| | |
|---|---|
| formula | Formula containing the (multivariate) ordinal response on the left side and the explanatory variables on the right side. |
| data | Data frame containing the ordinal responses as well as the explanatory variables from the formula. |
| control | Control argument for multord() function. For details see ctrl.multordRS. |
| se | Should standard errors be calculated for the regression coefficients? Default is TRUE. |
| model | Specifies, which type of model is used, either the (multivariate) adjacent categories model (model = "acat") or the (multivariate) cumulative model (model = "cumulative"). |

## Value

| | |
|---|---|
| beta.thresh | Matrix containing all threshold parameters for the respective model. |
| beta.shift | Vector containing all shift parameters. Only relevant if model = "acat" and thresholds.acat = "shift". |
| beta.X | Vector containing parameter estimates for the location effects of the explanatory variables. |
| beta.XRS | Vector containing parameter estimates for the response style effects of the explanatory variables. |
| Sigma | Estimate of the variance (or covariance matrix) of the random effects. The estimate is a matrix if person-specific random response style effects are considered in the model (i.e. if RS = TRUE). |
| Y | Matrix containing the explanatory variables. |
| X | Data frame containing the multivariate ordinal response, one row per obeservation, one column per response variable. |
| se.thresh | Matrix containing all standard errors of the threshold parameters for the respective model. |
| se.shift | Vector containing all standard errors of the shift parameters. Only relevant if model = "acat" and thresholds.acat = "shift". |
| se.X | Vector containing standard errors of the parameter estimates for the location effects of the explanatory variables. |
| se.XRS | Vector containing standard errors of the parameter estimates for the response style effects of the explanatory variables. |
| coef.vec | Complete vector of all parameter estimates (for internal use). |
| se.vec | Complete vector of all standard errors (for internal use). |
| design.values | Some values of the design matrix (for internal use). |
| loglik | (Marginal) Log Likelihood |
| call | Function call |
| df | Degrees of freedom |
| control | Control argument from function call |

## Author(s)

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https://orcid.org/0000-0002-0392-1580

## References

Schauberger, Gunther and Tutz, Gerhard (2021): Multivariate Ordinal Random Effects Models Including Subject and Group Specific Response Style Effects, *Statistical Modelling*, doi:10.1177/1471082X20978034

**See Also**

ctrl.multordRS MultOrdRS-package plot.MultOrdRS

**Examples**

```
data(tenseness)

## create a small subset of the data to speed up calculations
set.seed(1860)
tenseness <- tenseness[sample(1:nrow(tenseness), 300),]

## scale all metric variables to get comparable parameter estimates
tenseness$Age <- scale(tenseness$Age)
tenseness$Income <- scale(tenseness$Income)

## two formulas, one without and one with explanatory variables (gender and age)
f.tense0 <- as.formula(paste("cbind(",paste(names(tenseness)[1:4],collapse=","),") ~ 1"))
f.tense1 <- as.formula(paste("cbind(",paste(names(tenseness)[1:4],collapse=","),") ~ Gender + Age"))




####
## Adjacent Categories Models
####

## Multivariate adjacent categories model, without response style, without explanatory variables
m.tense0 <- multordRS(f.tense0, data = tenseness, control = ctrl.multordRS(RS = FALSE, cores = 2))
m.tense0




## Multivariate adjacent categories model, with response style as a random effect,
## without explanatory variables
m.tense1 <- multordRS(f.tense0, data = tenseness)
m.tense1

## Multivariate adjacent categories model, with response style as a random effect,
## without explanatory variables for response style BUT for location
m.tense2 <- multordRS(f.tense1, data = tenseness, control = ctrl.multordRS(XforRS = FALSE))
m.tense2

## Multivariate adjacent categories model, with response style as a random effect, with
## explanatory variables for location AND response style
m.tense3 <- multordRS(f.tense1, data = tenseness)
m.tense3

plot(m.tense3)




####
## Cumulative Models
```

```
####

## Multivariate cumulative model, without response style, without explanatory variables
m.tense0.cumul <- multordRS(f.tense0, data = tenseness, control = ctrl.multordRS(RS = FALSE),
  model = "cumulative")
m.tense0.cumul

## Multivariate cumulative model, with response style as a random effect,
## without explanatory variables
m.tense1.cumul <- multordRS(f.tense0, data = tenseness, model = "cumulative")
m.tense1.cumul

## Multivariate cumulative model, with response style as a random effect,
## without explanatory variables for response style BUT for location
m.tense2.cumul <- multordRS(f.tense1, data = tenseness, control = ctrl.multordRS(XforRS = FALSE),
  model = "cumulative")
m.tense2.cumul

## Multivariate cumulative model, with response style as a random effect, with
## explanatory variables for location AND response style
m.tense3.cumul <- multordRS(f.tense1, data = tenseness, model = "cumulative")
m.tense3.cumul

plot(m.tense3.cumul)

###################################################################
## Examples from Schauberger and Tutz (2020)
## Data from the German Longitudinal Election Study (GLES) 2017
###################################################################

####
## Source: German Longitudinal Election Study 2017
## Rossteutscher et al. 2017, https://doi.org/10.4232/1.12927
####

## load GLES data
data(GLES17)

## scale data
GLES17[,7:11] <- scale(GLES17[,7:11])

## define formula
f.GLES <- as.formula(cbind(RefugeeCrisis, ClimateChange, Terrorism,
                    Globalization, Turkey, NuclearEnergy) ~
                    Age + Gender + Unemployment + EastWest + Abitur)

## fit adjacent categories model without and with response style parameters
m.GLES0 <- multordRS(f.GLES, data = GLES17, control = ctrl.multordRS(RS = FALSE, cores = 6))
m.GLES <- multordRS(f.GLES, data = GLES17, control =  ctrl.multordRS(cores = 6))

m.GLES0
m.GLES
```

```
plot(m.GLES, main = "Adjacent categories model")


## fit cumulative model without and with response style parameters (takes pretty long!!!)
m.GLES20 <- multordRS(f.GLES, data = GLES17,  model="cumul",
control = ctrl.multordRS(opt.method = "nlminb", cores = 6, RS = FALSE))

m.GLES2 <- multordRS(f.GLES, data = GLES17,  model="cumul",
control = ctrl.multordRS(opt.method = "nlminb", cores = 6))

m.GLES20
m.GLES2

plot(m.GLES2, main = "Cumulative model")
```

---

plot.MultOrdRS                  *Plot function for MultOrdRS*

---

### Description

Plot function for a `MultOrdRS` object. Plots show coefficients of the explanatory variables, both
with repect to location and response styles. The coefficient pairs are displayed as stars, where the
rays represent (1-alpha) confidence intervals.

### Usage

```
## S3 method for class 'MultOrdRS'
plot(x, alpha = 0.05, CIfactor = 0.9,
xlab = expression(exp(gamma)), ylab = expression(exp(alpha)),
xlim = range(c(1,betaX.KI)), ylim = range(c(1,betaXRS.KI)), ...)
```

### Arguments

| | |
|---|---|
| x | MultOrdRS object |
| alpha | Specifies the confidence level 1-alpha of the confidence interval. |
| CIfactor | Argument that helps to control the appearance (the width) of the stars that represent the confidence intervals of both parameters (location and response style) corresponding to one covariate. |
| xlab | Label for x-axis |
| ylab | Label for y-axis |
| xlim | Limits for x-axis |
| ylim | Limits for y-axis |
| ... | Further plot arguments. |

**Value**

No return value, called for side effects

**Author(s)**

Gunther Schauberger
<gunther.schauberger@tum.de>
https://orcid.org/0000-0002-0392-1580

**References**

Schauberger, Gunther and Tutz, Gerhard (2021): Multivariate Ordinal Random Effects Models Including Subject and Group Specific Response Style Effects, *Statistical Modelling*, doi:10.1177/1471082X20978034

**See Also**

multordRS, ctrl.multordRS

**Examples**

```
data(tenseness)

## create a small subset of the data to speed up calculations
set.seed(1860)
tenseness <- tenseness[sample(1:nrow(tenseness), 300),]

## scale all metric variables to get comparable parameter estimates
tenseness$Age <- scale(tenseness$Age)
tenseness$Income <- scale(tenseness$Income)

## two formulas, one without and one with explanatory variables (gender and age)
f.tense0 <- as.formula(paste("cbind(",paste(names(tenseness)[1:4],collapse=","),") ~ 1"))
f.tense1 <- as.formula(paste("cbind(",paste(names(tenseness)[1:4],collapse=","),") ~ Gender + Age"))



####
## Adjacent Categories Models
####

## Multivariate adjacent categories model, without response style, without explanatory variables
m.tense0 <- multordRS(f.tense0, data = tenseness, control = ctrl.multordRS(RS = FALSE))
m.tense0


## Multivariate adjacent categories model, with response style as a random effect,
## without explanatory variables
m.tense1 <- multordRS(f.tense0, data = tenseness)
m.tense1
```

```
## Multivariate adjacent categories model, with response style as a random effect,
## without explanatory variables for response style BUT for location
m.tense2 <- multordRS(f.tense1, data = tenseness, control = ctrl.multordRS(XforRS = FALSE))
m.tense2

## Multivariate adjacent categories model, with response style as a random effect, with
## explanatory variables for location AND response style
m.tense3 <- multordRS(f.tense1, data = tenseness)
m.tense3

plot(m.tense3)



####
## Cumulative Models
####

## Multivariate cumulative model, without response style, without explanatory variables
m.tense0.cumul <- multordRS(f.tense0, data = tenseness,
  control = ctrl.multordRS(RS = FALSE), model = "cumulative")
m.tense0.cumul

## Multivariate cumulative model, with response style as a random effect,
## without explanatory variables
m.tense1.cumul <- multordRS(f.tense0, data = tenseness, model = "cumulative")
m.tense1.cumul

## Multivariate cumulative model, with response style as a random effect,
## without explanatory variables for response style BUT for location
m.tense2.cumul <- multordRS(f.tense1, data = tenseness,
  control = ctrl.multordRS(XforRS = FALSE), model = "cumulative")
m.tense2.cumul

## Multivariate cumulative model, with response style as a random effect, with
## explanatory variables for location AND response style
m.tense3.cumul <- multordRS(f.tense1, data = tenseness, model = "cumulative")
m.tense3.cumul

plot(m.tense3.cumul)

###################################################################
## Examples from Schauberger and Tutz (2020)
## Data from the German Longitudinal Election Study (GLES) 2017
###################################################################

####
## Source: German Longitudinal Election Study 2017
## Rossteutscher et al. 2017, https://doi.org/10.4232/1.12927
####

## load GLES data
data(GLES17)
```

```
## scale data
GLES17[,7:11] <- scale(GLES17[,7:11])

## define formula
f.GLES <- as.formula(cbind(RefugeeCrisis, ClimateChange, Terrorism,
                      Globalization, Turkey, NuclearEnergy) ~
                      Age + Gender + Unemployment + EastWest + Abitur)

## fit adjacent categories model without and with response style parameters
m.GLES0 <- multordRS(f.GLES, data = GLES17, control = ctrl.multordRS(RS = FALSE, cores = 6))
m.GLES <- multordRS(f.GLES, data = GLES17, control =  ctrl.multordRS(cores = 6))

m.GLES0
m.GLES

plot(m.GLES, main = "Adjacent categories model")


## fit cumulative model without and with response style parameters (takes pretty long!!!)
m.GLES20 <- multordRS(f.GLES, data = GLES17,  model="cumul",
control = ctrl.multordRS(opt.method = "nlminb", cores = 6, RS = FALSE))

m.GLES2 <- multordRS(f.GLES, data = GLES17,  model="cumul",
control = ctrl.multordRS(opt.method = "nlminb", cores = 6))

m.GLES20
m.GLES2

plot(m.GLES2, main = "Cumulative model")
```

---

| tenseness | *Tenseness data from the Freiburg Complaint Checklist (tenseness)* |
|---|---|

---

### Description

Data from the Freiburg Complaint Checklist. The data contain all 8 items corresponding to the scale *Tenseness* for 1847 participants of the standardization sample of the Freiburg Complaint Checklist. Additionally, several person characteristics are available.

### Format

A data frame containing data from the Freiburg Complaint Checklist with 1847 observations. All items refer to the scale *Tenseness* and are measured on a 5-point Likert scale where low numbers correspond to low frequencies or low intensitites of the respective complaint and vice versa.

**Clammy_hands** Do you have clammy hands?

**Sweat_attacks** Do you have sudden attacks of sweating?

**Clumsiness** Do you notice that you behave clumsy?

**Wavering_hands** Are your hands wavering frequently, e.g. when lightning a cigarette or when holding a cup?

**Restless_hands** Do you notice that your hands are restless?

**Restless_feet** Do you notice that your feet are restless?

**Twitching_eyes** Do you notice unvoluntary twitching of your eyes?

**Twitching_mouth** Do you notice unvoluntary twitching of your mouth?

**Gender** Gender of the participant

**Household** Does participant live alone in a houshold or together with others?

**WestEast** is the participant from East Germany (former GDR) or West Germany?

**Age** Age in 15 categories, treated as continuous variable

**Abitur** Does the participant have Abitur (a-levels)?

**Income** Income in 11 categories, treated as continuous variable

### Source

ZPID (2013). PsychData of the Leibniz Institute for Psychology Information ZPID. Trier: Center for Research Data in Psychology.

Fahrenberg, J. (2010). Freiburg Complaint Checklist [Freiburger Beschwerdenliste (FBL)]. Goettingen, Hogrefe.

### Examples

```
data(tenseness)

## create a small subset of the data to speed up calculations
set.seed(1860)
tenseness <- tenseness[sample(1:nrow(tenseness), 300),]

## scale all metric variables to get comparable parameter estimates
tenseness$Age <- scale(tenseness$Age)
tenseness$Income <- scale(tenseness$Income)

## two formulas, one without and one with explanatory variables (gender and age)
f.tense0 <- as.formula(paste("cbind(",paste(names(tenseness)[1:4],collapse=","),") ~ 1"))
f.tense1 <- as.formula(paste("cbind(",paste(names(tenseness)[1:4],collapse=","),") ~ Gender + Age"))



####
## Adjacent Categories Models
####

## Multivariate adjacent categories model, without response style, without explanatory variables
m.tense0 <- multordRS(f.tense0, data = tenseness, control = ctrl.multordRS(RS = FALSE))
m.tense0
```

```
## Multivariate adjacent categories model, with response style as a random effect,
## without explanatory variables
m.tense1 <- multordRS(f.tense0, data = tenseness)
m.tense1

## Multivariate adjacent categories model, with response style as a random effect,
## without explanatory variables for response style BUT for location
m.tense2 <- multordRS(f.tense1, data = tenseness, control = ctrl.multordRS(XforRS = FALSE))
m.tense2

## Multivariate adjacent categories model, with response style as a random effect, with
## explanatory variables for location AND response style
m.tense3 <- multordRS(f.tense1, data = tenseness)
m.tense3

plot(m.tense3)



####
## Cumulative Models
####

## Multivariate cumulative model, without response style, without explanatory variables
m.tense0.cumul <- multordRS(f.tense0, data = tenseness, control =
  ctrl.multordRS(RS = FALSE), model = "cumulative")

m.tense0.cumul

## Multivariate cumulative model, with response style as a random effect,
## without explanatory variables
m.tense1.cumul <- multordRS(f.tense0, data = tenseness, model = "cumulative")
m.tense1.cumul

## Multivariate cumulative model, with response style as a random effect,
## without explanatory variables for response style BUT for location
m.tense2.cumul <- multordRS(f.tense1, data = tenseness,
  control = ctrl.multordRS(XforRS = FALSE), model = "cumulative")

m.tense2.cumul

## Multivariate cumulative model, with response style as a random effect,
## with explanatory variables
## for location AND response style
m.tense3.cumul <- multordRS(f.tense1, data = tenseness, model = "cumulative")
m.tense3.cumul

plot(m.tense3.cumul)
```

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