

Package "hopit"

January 21, 2019

anova.hopit

Likelihood Ratio Test Tables

Description

Compute likelihood ratio test for two or more hopit objects.

Usage

```
## S3 method for class 'hopit'  
anova(object, ..., method = c("sequential", "with.most.complex", 'with.least.complex'),  
direction = c("decreasing", "increasing"))
```

Arguments

object	an object containing the results returned by a hopit.
...	additional objects of the same type.
method	the method of model comparison. Choose "sequential" for 1-2, 2-3, 3-4, ... comparisons or "with.most.complex" for 1-2, 1-3, 1-4, ... comparisons, where 1 is the most complex model.
direction	determine if complexity of listed models is "increasing" or "decreasing" (default).

Value

a vector or a matrix with results of the test(s).

Author(s)

Maciej J. Danko

See Also

[print.anova.hopit](#), [print.lrt.hopit](#), [lrt.hopit](#), [hopit](#).

Examples

```

# DATA
data(healthsurvey)

# the order of response levels is decreasing (from the best health to the worst health)
levels(healthsurvey$health)

# Example 1 -----

# fitting two nested models
model1 <- hopit(latent.formula = health ~ hypertension + high_cholesterol +
  heart_attack_or_stroke + poor_mobility + very_poor_grip +
  depression + respiratory_problems +
  IADL_problems + obese + diabetes + other_diseases,
  thresh.formula = ~ sex + ageclass + country,
  decreasing.levels = TRUE,
  control = list(trace = FALSE),
  data = healthsurvey)

# model with interaction between hypertension and high_cholesterol
model2 <- hopit(latent.formula = health ~ hypertension * high_cholesterol +
  heart_attack_or_stroke + poor_mobility + very_poor_grip +
  depression + respiratory_problems +
  IADL_problems + obese + diabetes + other_diseases,
  thresh.formula = ~ sex + ageclass + country,
  decreasing.levels = TRUE,
  control = list(trace = FALSE),
  data = healthsurvey)

# Likelihood ratio test
lrt1 <- anova(model1, model2)
lrt1

# print results in shorter form
print(lrt1, short = TRUE)

# equivalently
lrt.hopit(model2, model1)

# Example 2 -----

# fitting additional nested models
model3 <- hopit(latent.formula = health ~ hypertension * high_cholesterol +
  heart_attack_or_stroke + poor_mobility + very_poor_grip +
  depression + respiratory_problems +
  IADL_problems + obese * diabetes + other_diseases,
  thresh.formula = ~ sex + ageclass + country,
  decreasing.levels = TRUE,
  control = list(trace = FALSE),
  data = healthsurvey)

model4 <- hopit(latent.formula = health ~ hypertension * high_cholesterol +

```

```

        heart_attack_or_stroke + poor_mobility + very_poor_grip +
        depression + respiratory_problems +
        IADL_problems + obese * diabetes + other_diseases,
thresh.formula = ~ sex * ageclass + country,
decreasing.levels = TRUE,
control = list(trace = FALSE),
data = healthsurvey)

# sequential likelihood ratio tests
# model complexity increases so direction = "increasing"
anova(model1, model2, model3, model4,
       direction = "increasing", method = "sequential")

# likelihood ratio tests of the most complex model with the rest
anova(model1, model2, model3, model4,
       direction = "increasing", method = "with.most.complex")

# likelihood ratio tests of the least complex model with the rest
anova(model1, model2, model3, model4,
       direction = "increasing", method = "with.least.complex")

```

boot_hopit_CI	<i>Calculating confidence intervals of a boot object using percentile method</i>
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Description

Calculating confidence intervals of a boot object using percentile method

Usage

```
boot_hopit_CI(boot, alpha = 0.05, bounds = c("both", "lo", "up"))
```

Arguments

boot	a boot object calculated by boot_hopit .
alpha	significance level.
bounds	one of "both", "lo", "up".

Author(s)

Maciej J. Danko

See Also

[boot_hopit](#), [getLevels](#), [getCutPoints](#), [latentIndex](#), [standardiseCoef](#), [hopit](#).

Examples

```
# see examples in boot_hopit() function.
```

boot_hopit	<i>Bootstrapping hopit model</i>
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Description

boot_hopit performs bootstrap of a function dependent on fitted model. In each of the bootstrap repetitions a set of new model coefficients is drawn from the multivariate normal distribution, assuming originally estimated model coefficients (see [coef.hopit](#)) as a mean and using model variance-covariance matrix (see [vcov.hopit](#)). The drawn coefficients are then used to calculate the measure of interest using a function delivered by func parameter.

Usage

```
boot_hopit(model, data, func, nboot = 500, unlist = TRUE,  
           boot.only.latent = TRUE, robust.vcov = TRUE, ...)
```

Arguments

model	a fitted hopit model.
data	data used to fit the model.
func	function to be bootstrapped of the form <code>func(model, data, ...)</code> .
nboot	number of bootstrap replicates.
unlist	logical indicating if to unlist boot object.
boot.only.latent	logical indicating if to perform the bootstrap only on latent variables.
robust.vcov	see vcov.hopit .
...	other parameters passed to the func.

Value

a list with bootstrapped elements.

Author(s)

Maciej J. Danko

See Also

[boot_hopit_CI](#), [getLevels](#), [getCutPoints](#), [latentIndex](#), [standardiseCoef](#), [hopit](#).

Examples

```

# DATA
data(healthsurvey)

# the order of response levels is decreasing (from the best health to the worst health)
levels(healthsurvey$health)

# fitting a model
model1 <- hopit(latent.formula = health ~ hypertension + high_cholesterol +
               heart_attack_or_stroke + poor_mobility + very_poor_grip +
               depression + respiratory_problems +
               IADL_problems + obese + diabetes + other_diseases,
               thresh.formula = ~ sex + ageclass + country,
               decreasing.levels = TRUE,
               control = list(trace = FALSE),
               data = healthsurvey)

# Example 1 -----
# Bootstrapping cut-points

# Function to be bootstrapped
cutpoints <- function(model, data) getCutPoints(model, plotf = FALSE)$cutpoints
B <- boot_hopit(model = model1, data = healthsurvey,
               func = cutpoints, nboot = 100)

# Calculate lower and upper bounds using percentile method
cutpoints.CI <- boot_hopit_CI(B)

# print estimated cutpoints and their confidence intervals
cutpoints(model1, healthsurvey)
cutpoints.CI

# Example 2 -----
# Bootstrapping health levels differences

# Function to be bootstrapped
diff_BadHealth <- function(model, data) {
  hl <- getLevels(model = model, formula=~ sex + ageclass, data = data,
                 sep=' ', plotf=FALSE)
  hl$original[,1] + hl$original[,2] - hl$adjusted[,1]- hl$adjusted[,2]
}

# Estimate of the difference
est.org <- diff_BadHealth(model = model1, data = healthsurvey)

# Perform the bootstrap
B <- boot_hopit(model = model1, data = healthsurvey,
               func = diff_BadHealth, nboot = 100)

# Calculate lower and upper bounds using percentile method
est.CI <- boot_hopit_CI(B)

```

```
# Plotting the difference and its (asymmetrical) confidence intervals
pmar <- par('mar'); par(mar = c(9.5,pmar[2:4]))
m <- max(abs(est.CI))
pos <- barplot(est.org, names.arg = names(est.org), las = 3, ylab = 'Original - Adjusted',
               ylim=c(-m, m), density = 20, angle = c(45, -45), col = c('blue', 'orange'))
for (k in seq_along(pos)) lines(c(pos[k,1],pos[k,1]), est.CI[,k], lwd = 2, col = 2)
abline(h = 0); box(); par(mar = pmar)
```

calcYYY

INTERNAL: Calculate special matrices for gradient calculation

Description

INTERNAL: Calculate special matrices for gradient calculation

Usage

```
calcYYY(model)
```

Arguments

model fitted model.

Value

updated model.

Author(s)

Maciej J. Danko

getCutPoints

Calculate threshold cut-points using Jorges' method

Description

Calculate threshold cut-points using Jorges' method.

Usage

```
getCutPoints(model, subset = NULL, plotf = TRUE, mar = c(4, 4, 1, 1),
             oma = c(0, 0, 0, 0), XLab = "Health index", XLab.cex = 1.1,
             YLab = "Counts", YLab.cex = 1.1, decreasing.levels = TRUE,
             group.labels.type = c("middle", "border", "none"))
```

Arguments

model a fitted `hopit` model.
subset an optional vector specifying a subset of observations.
plotf a logical indicating if to plot the results.
mar, oma see [par](#).
XLab, XLab.cex label and size of the label for x axis.
YLab, YLab.cex label and size of the label for y axis.
decreasing.levels logical indicating if self-reported health classes are ordered in decreasing order.
group.labels.type position of the legend. One of `middel`, `border`, or `none`.

Value

a list with following components:

cutpoints cutpoints for adjusted categorical response levels with corresponding percentiles of latent index.
adjusted.levels adjusted categorical response levels for each individual.

Author(s)

Maciej J. Danko

References

\insertRefJurges2007hopit

See Also

[latentIndex](#), [standardiseCoef](#), [getLevels](#), [hopit](#).

Examples

```

# DATA
data(healthsurvey)

# the order of response levels is decreasing (from the best health to the worst health)
levels(healthsurvey$health)

# Example 1 -----

# fitting a model
model1 <- hopit(latent.formula = health ~ hypertension + high_cholesterol +
  heart_attack_or_stroke + poor_mobility + very_poor_grip +
  depression + respiratory_problems +
  IADL_problems + obese + diabetes + other_diseases,
  thresh.formula = ~ sex + ageclass + country,
```

```

        decreasing.levels = TRUE,
        control = list(trace = FALSE),
        data = healthsurvey)

# health index cut-points
z <- getCutPoints(model = model1)
z$cutpoints

# adjusted health levels for individuals: Jorges method
rev(table(z$adjusted.levels))

# original health levels for individuals
table(model1$y_i)

# adjusted health levels for individuals: Estimated model thresholds
table(model1$Ey_i)

```

getLevels

Summarize adjusted and original response levels.

Description

Summarize adjusted and original response levels

Usage

```

getLevels(model, formula = model$thresh.formula,
  data = environment(model$thresh.formula), decreasing.levels = TRUE,
  sort.flag = FALSE, plotf = TRUE, sep = "_", mar = c(7, 2, 1.5, 0.5),
  oma = c(0, 3, 0, 0), YLab = "Fraction [%]", YLab.cex = 1.1,
  legbg = adjustcolor("white", alpha.f = 0.4), legbty = "o")

```

Arguments

model	a fitted hopit model.
formula	a formula containing the grouping variables. It is by default set to threshold formula.
data	data used to fit the model.
decreasing.levels	logical indicating if self-reported health classes are ordered in increasing order.
sort.flag	logical indicating if to sort the levels.
plotf	a logical indicating if to plot the results.
sep	separator for levels names.
mar, oma	see par .
YLab, YLab.cex	label and size of the label for y axis.
legbg	legend background color. See bg parameter in legend .
legbty	legend box type. See bty parameter in legend .

Value

a list with following components:

original	frequencies of original response levels for selected groups/categories.
adjusted	frequencies of adjusted response levels (Jurges 2007 method) for selected groups/categories.
N.original	numbers of original response levels for selected groups/categories.
N.adjusted	numbers of adjusted response levels (Jurges 2007 method) for selected groups/categories.
categories	selected groups/categories used in summary.
tab	original vs. adjusted contingency table.
mat	a matrix with columns: grouping variables, original response levels, adjusted response levels. Each row corresponds to a single individual from the data used to fit the model.

Author(s)

Maciej J. Danko

References

\insertRefJurges2007hopit

See Also

[getCutPoints](#), [latentIndex](#), [standardiseCoef](#), [hopit](#).

Examples

```
# DATA
data(healthsurvey)

# the order of response levels is decreasing (from the best health to the worst health)
levels(healthsurvey$health)

# fitting a model
model1 <- hopit(latent.formula = health ~ hypertension + high_cholesterol +
  heart_attack_or_stroke + poor_mobility + very_poor_grip +
  depression + respiratory_problems +
  IADL_problems + obese + diabetes + other_diseases,
  thresh.formula = ~ sex + ageclass + country,
  decreasing.levels = TRUE,
  control = list(trace = FALSE),
  data = healthsurvey)

# Example 1 -----

# summary by country
h1 <- getLevels(model=model1, formula=~ country,
  data = healthsurvey,
  sep=' ', plotf=TRUE)
```

```

# differences in frequencies between original and adjusted health levels
round(100*(hl$original - hl$adjusted),2)

# extract good and bad health (combine levels)
Org <- cbind(bad = rowSums(hl$original[,1:2]), good = rowSums(hl$original[,4:5]))
Adj <- cbind(bad = rowSums(hl$adjusted[,1:2]), good = rowSums(hl$adjusted[,4:5]))
round(100*(Org - Adj),2)

# plot the differences
barplot(t(Org - Adj), beside = TRUE, density = 20, angle = c(-45, 45),
        col = c('pink4', 'green2'), ylab = 'Original - adjusted reported health frequencies')
abline(h = 0); box()
legend('top', c('Bad health','Good health'), density = 20, angle = c(-45, 45),
        fill = c('pink4', 'green2'), bty = 'n', cex = 1.2)

# in country X the bad health seems to be over-reported and good health under reported,
# in country Z the good health is highly over-reported.

# Example 2 -----

# summary by gender and age
hl <- getLevels(model1, formula=~ sex + ageclass,
                data = healthsurvey,
                sep=' ', plotf=TRUE)

# differences in frequencies between original and adjusted health levels
round(100*(hl$original - hl$adjusted),2)

# extract good health levels (combined "Very good" and "Excelent" levels)
Org <- rowSums(hl$original[,4:5])
Adj <- rowSums(hl$adjusted[,4:5])
round(100*(Org - Adj),2)

pmar <- par('mar'); par(mar = c(9.5, pmar[2:4]))
barplot(Org-Adj, ylab = 'Original - adjusted reported good health frequencies', las = 3,
        density = 20, angle = c(45, -45), col = c('blue', 'orange'))
abline(h = 0); box(); par(mar = pmar)
legend('top', c('Man','Woman'), density = 20, angle = c(-45, 45),
        fill = c('blue', 'orange'), bty = 'n', cex = 1.2)

# the results show that women in general tends to over-report good health.
# men in ages 50-59 greatly under-report good health.

# more examples can be found in the description of boot.hopit() function.

```

getTheta

Extract Theta parameter from the hopit model

Description

Extract Theta parameter from the hopit model

Usage

getTheta(model)

Arguments

model a fitted hopit model.

Author(s)

Maciej J. Danko

%c% *Check if one set is a subset of an another subset*

Description

Check if one set is a subset of an another subset

Usage

x %c% y

Arguments

x, y numeric vectors

Author(s)

Maciej J. Danko

%notc% *Not %c% function*

Description

Not %c% function

Usage

x %notc% y

Arguments

x, y numeric vectors

Author(s)

Maciej J. Danko

%notin%	<i>Not %in% function</i>
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Description

Not %in% function

Usage

x %notin% y

Arguments

x, y numeric vectors

Author(s)

Maciej J. Danko

healthsurvey	<i>Artificially generated health survey data</i>
--------------	--

Description

A dataset containing artificially generated survey data

Usage

healthsurvey

Format

A data frame with 10000 rows and 11 variables:

ID personal identification number.

health reported health, 5 levels.

diabetes has diabetes? "yes" or "no"?

obese has obese? "yes" or "no"?

IADL_problems problems in Instrumental Activities of Daily Living? "yes" or "no"?

hypertension has hypertension? "yes" or "no"?

high_cholesterol has high cholesterol? "yes" or "no"?

respiratory_problems has respirator problems? "yes" or "no"?

heart_attack_or_stroke had stroke or heart attack? "yes" or "no"?

poor_mobility has poor mobility? "yes" or "no"?

very_poor_grip cannot perform grip strength? "yes" or "no"?

depression has depression? "yes" or "no"?

other_diseases has other diseases? "yes" or "no"?

sex sex/gender: woman or man.

ageclass categorized age: [50,60), [60,70), [70,80), [80,120).

education two levels of education: primary or lower and secondary or higher.

country country: X, Y, or Z.

csw cross-sectional survey weights.

psu primary statistical unit.

ssu secondary statistical unit.

Source

Data was randomly generated using probabilities of occurrence of particular combination of diseases, conditions, sex, age, education, reported health, etc. The structure of the data and some probabilities were inspired by WAVE1 SHARE database (DOIs: 10.6103/SHARE.w1.600), see Börsch-Supan et al for methodological details (Börsch-Supan et al. 2013).

The SHARE data collection has been primarily funded by the European Commission through FP5 (QLK6-CT-2001-00360), FP6 (SHARE-I3: RII-CT-2006-062193, COMPARE: CIT5-CT-2005-028857, SHARELIFE: CIT4-CT-2006-028812) and FP7 (SHARE-PREP: N°211909, SHARE-LEAP: N°227822, SHARE M4: N°261982). Additional funding from the German Ministry of Education and Research, the Max Planck Society for the Advancement of Science, the U.S. National Institute on Aging (U01_AG09740-13S2, P01_AG005842, P01_AG08291, P30_AG12815, R21_AG025169, Y1-AG-4553-01, IAG_BSR06-11, OGHA_04-064, HHSN271201300071C) and from various national funding sources is gratefully acknowledged (see www.share-project.org).

None of the individuals (records) represent any true individual (record) of the SHARE database

References

Börsch-Supan A, Brandt M, Hunkler C, et al (2013) Data resource profile: The survey of health, ageing and retirement in europe (share). *Int J Epidemiol* 42:992–1001. doi: 10.1093/ije/dyt088

Examples

```
# load *healthsurvey* dataset
data(healthsurvey)

# horizontal view on the dataset (omitting ID)
print(t(healthsurvey[1:6,-1]), quote=FALSE, na.print='NA', right=TRUE)
```

hopit_c_link	<i>INTERNAL: Decode link parameter</i>
--------------	--

Description

INTERNAL: Decode link parameter

Usage

```
hopit_c_link(model)
```

Arguments

model	fitted model.
-------	---------------

Value

updated model.

Author(s)

Maciej J. Danko

hopit.control	<i>Auxiliary for controlling the fitting of hopit model</i>
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Description

Auxiliary function for controlling the fitting of hopit model. Use this function to set control parameters of the [hopit](#) and other related functions.

Usage

```
hopit.control(grad.eps = 3e-05, bgfs.maxit = 10000, cg.maxit = 10000,
  nlm.maxit = 150, bgfs.reltol = 5e-10, cg.reltol = 5e-10,
  nlm.gradtol = 1e-07, nlm.steptol = 1e-07, fit.methods = c("CG", "BFGS"),
  quick.fit = TRUE, trace = TRUE, thresh.start = -Inf,
  thresh.1.exp = FALSE, LL_out_val = -Inf)
```

Arguments

<code>grad.eps</code>	epsilon for numerical Hessian function.
<code>bgfs.maxit</code> , <code>cg.maxit</code> , <code>nlm.maxit</code>	the maximum number of iterations. See optim and nlm for details.
<code>bgfs.reltol</code> , <code>cg.reltol</code>	relative convergence tolerance. See optim for details.
<code>nlm.gradtol</code> , <code>nlm.steptol</code>	tolerance at which the scaled gradient is considered close enough to zero and minimum allowable relative step length. See nlm .
<code>fit.methods</code>	either 'CG' or 'BFGS'. See optim .
<code>quick.fit</code>	logical, if TRUE extensive nlm optimization method is ignored and only BFGS and CG methods are run.
<code>trace</code>	logical, if to trace model fitting.
<code>LL_out_val</code> , <code>thresh.1.exp</code> , <code>thresh.start</code>	internal parameters under development, do not change.

Author(s)

Maciej J. Danko

See Also

[hopit](#)

hopit

Generalized hierarchical ordered threshold models.

Description

The ordered response data classifies a measure of interest into ordered categories collected during a survey. If the dependent variable is a happiness then a respondent typically answers a question: “Taking all things together, would you say you are ...?” and have some response options e.g. “very happy”, “pretty happy”, “not too happy”, “very unhappy” \insertCiteLiao2005hopit. Similarly if interviewees are asked to evaluate their health in general (e.g. “Would you say your health is ...?”) they may choose among several categories, e.g. very good, good, fair, bad, and very bad \insertCiteKing2004,Jurges2007,Rebelo2014hopit. In political sciences a respondent may be asked for an opinion about recent legislation (e.g. “Rate your feelings about the proposed legislation”) and asked to choose among several categories “strongly oppose”, “mildly oppose”, “indifferent”, “mildly support”, “strongly support” \insertCiteGreeneHensher2010hopit. It is easy to imagine other multi-level ordinal variables that might be used during the survey and to which methodology described below could be applied with.

Practically, it is assumed that when responding to a survey question about their general happiness, health, feeling, attitude or other status, participants assess their true value of this unobserved continuous variable, and project it to a provided discrete scale. The thresholds that each individual

uses to categorize their true status into a specific response option may be affected by the choice of a reference group, earlier life experiences, and cross-cultural differences in using scales, and thus, may differ across individuals depending on their gender, age, cultural background, education, and personality traits, among other factors.

From the reporting-styles modeling perspective, one of the main tasks is to compute this continuous estimate of individuals' underlying, latent measure based on several specific characteristics of the considered response (e.g. health variables or happiness variables) and accounting also for variations in reporting across socio-demographic and cultural groups. More specifically, to build the latent, underlying measure a generalized hierarchical ordered threshold model is fitted, which regresses the reported status/attitude/feeling on two sets of independent variables \insertCiteBoes2006,Green2014hopit. When a dependent reported ordered variable is self-rated health status then the first set of variables (health variables) assesses individuals' specific aspects of health, and might include chronic conditions, mobility level, difficulties with a range of daily activities, performance on grip strength test, anthropometric measures, lifestyle behaviors, etc. Using the second set of independent variables (threshold variables), the model also adjusts for the differences across socio-demographic and cultural groups like cultural background, gender, age, education, etc. \insertCiteKing2004,Jurges2007hopit.

Ordered threshold models are used to fit ordered categorical dependent variables. The generalized ordered threshold models \insertCiteTerza1985,Boes2006,Green2014hopit are an extension to the ordered threshold models \insertCiteMcKelvey1975hopit. In the latter models the thresholds are constant, whereas generalized models allows thresholds to be dependent on covariates. \insertCiteGreeneHensher2010,Green2014;textualhopit pointed out that also thresholds must be ordered so that a model has a sense. This motivated Greene and coauthors to call this models *HOPIT*, which stands for hierarchical ordered probit models.

The fitted *hopit* model is used to analyse reporting styles. See [standardizeCoef](#), [latentIndex](#), [getCutPoints](#), and [getLevels](#).

Usage

```
hopit(latent.formula, thresh.formula = ~1, crossinter.formula = ~1, data,
      decreasing.levels, start = NULL, overdispersion = FALSE,
      design = list(), weights = NULL, link = c("probit", "logit"),
      control = list())
```

Arguments

latent.formula formula used to model latent variable. It should not contain any threshold variable. To specify interactions between latent and threshold variables see `crossinter.formula`

thresh.formula formula used to model threshold variable. It should not contain any latent variable. To specify interactions between latent and threshold variables see `crossinter.formula` Any dependent variable (left side of "~") will be ignored.

crossinter.formula

formula used to model interactions between threshold and latent variables. The formula should be in the form `"~ thresh.var.X : latent.var.Y + thresh.var.Z : latent.var.Q +`

	All "latent.vars" must be present in threshold formula and all "thresh.vars" must be present in threshold formula. Any dependent variable (left side of "~") will be ignored.
data	a data frame including all modeled variables.
decreasing.levels	logical indicating if self-reported health classes are ordered in decreasing order.
start	a vector with starting coefficient values in the form <code>c(latent_parameters, threshold_lambdas, thresh...</code>
overdispersion	logical indicating if to fit additional parameter theta, which models a variance of the error term.
design	an optional survey design. Use svydesign function to specify the design. The design cannot be specified together with parameter weights.
weights	an optional weights. Use design to construct survey weights.
link	the link function. The possible values are "probit" (default) and "logit".
control	a list with control parameters. See hopit.control .

Details

The function fits generalized hierarchical ordered threshold models.

`latent.formula` models latent variable. if the response variable is self-rated health then latent measure can depend on different health conditions and diseases (latent variables are called health variables). Latent variables are modeled with parallel regression assumption. According to the assumption, coefficients, which describe the relationship between lowest and all higher response categories, are the same as those coefficients, which describe the relationship between another (e.g. adjacent) lowest and the remaining higher response categories. The predicted latent variable is modeled as a linear function of health variables and corresponding coefficients.

`thresh.formula` models threshold variable. The thresholds (cut points, alpha) are modeled by threshold variables gamma and intercepts lambda. It is assumed that they model contextual characteristics of the respondent (e.g. country, gender, age, etc.). Threshold variables are modeled without parallel regression assumption, thus each threshold is modeled by a variable independently \insertCiteBoes2006,Green2014hopit. `hopit()` function uses parametrization of thresholds proposed by \insertCiteJurges2007;textualhopit.

`decreasing.levels` it is the logical that determines the ordering of levels of the categorical response variable. It is always good to check first the ordering of the levels before starting (see example 1)

Value

a `hopit` object used by other functions and methods. The object is a list with following components:

control	a list with control parameters. See hopit.control .
link	used link function.

<code>hasdisp</code>	logical, was overdispersion modeled?
<code>latent.formula</code>	used latent formula.
<code>latent.mm</code>	latent model matrix.
<code>latent.terms</code>	used latent variables.
<code>thresh.formula</code>	used threshold formula.
<code>thresh.mm</code>	threshold model matrix.
<code>thresh.extd</code>	threshold extended model matrix.
<code>thresh.terms</code>	used threshold variables.
<code>thresh.no.cov</code>	logical, are gamma parameters present?
<code>parcount</code>	3-element vector with number of parameters for latent variable (beta), threshold intercept (lambda), and threshold covariates (gamma).
<code>coef</code>	a vector with coefficients.
<code>coef.ls</code>	coefficients as a list.
<code>start</code>	vector with starting values of coefficients.
<code>alpha</code>	estimated individual-specific thresholds.
<code>y_i</code>	response variable.
<code>y_latent_i</code>	predicted latent measure.
<code>Ey_i</code>	predicted categorical response.
<code>J</code>	number of response levels.
<code>N</code>	number of observations.
<code>deviance</code>	deviance.
<code>LL</code>	log likelihood.
<code>AIC</code>	AIC for models without survey design.
<code>vcov</code>	variance-covariance matrix.
<code>hessian</code>	a Hessian matrix.
<code>estfun</code>	gradient of the log likelihood function at estimated coefficient values.
<code>YYY1, YYY2, YYY3</code>	internal objects used for calculation of gradient and Hessian functions.
<code>use.weights, vcov.basic, glm.start, glm.start.ls</code>	other internal objects.

Author(s)

Maciej J. Danko

References

\insertAllCited

See Also

[coef.hopit](#), [profile.hopit](#), [hopit.control](#), [anova.hopit](#), [vcov.hopit](#), [logLik.hopit](#), [AIC.hopit](#), [summary.hopit](#), [svydesign](#),

For reporting styles analysis see:

[standardizeCoef](#), [latentIndex](#), [getCutPoints](#), [getLevels](#).

Examples

```
# DATA
data(healthsurvey)

# first determine the order of the dependent variable
levels(healthsurvey$health)

# Example 1 -----

# the order is decreasing (from the best health to the worst health)
# so we set: decreasing.levels = TRUE
# fitting the model:
model1 <- hopit(latent.formula = health ~ hypertension + high_cholesterol +
  heart_attack_or_stroke + poor_mobility + very_poor_grip +
  depression + respiratory_problems +
  IADL_problems + obese + diabetes + other_diseases,
  thresh.formula = ~ sex + ageclass + country,
  decreasing.levels = TRUE,
  control = list(trace = FALSE),
  data = healthsurvey)

# summarize the fit:
summary(model1)

# extract parameters in a form of list
cm1 <- coef(model1, aslist = TRUE)

# names of returned coefficients
names(cm1)

# extracting latent health coefficients
cm1$latent.params

# Checking the fit
profile(model1)

# Example 2 -----

# incorporating survey design
design <- svydesign(ids = ~ country + psu, weights = healthsurvey$csw,
  data = healthsurvey)

model2 <- hopit(latent.formula = health ~ hypertension + high_cholesterol +
  heart_attack_or_stroke + poor_mobility +
```

```

        very_poor_grip + depression + respiratory_problems +
        IADL_problems + obese + diabetes + other_diseases,
thresh.formula = ~ sex + ageclass + country,
decreasing.levels = TRUE,
design = design,
control = list(trace = FALSE),
data = healthsurvey)

# compare latent variables
cbind('No survey design' = coef(model1, aslist = TRUE)$latent.par,
'Has survey design' = coef(model2, aslist = TRUE)$latent.par)

# Example 3 -----

# using crossinter.formula
model3 <- hopit(latent.formula = health ~ hypertension + high_cholesterol +
        heart_attack_or_stroke + poor_mobility + very_poor_grip +
        depression + respiratory_problems +
        IADL_problems + obese + diabetes + other_diseases,
thresh.formula = ~ sex + ageclass + country,
crossinter.formula = ~ sex : depression + sex : diabetes,
decreasing.levels = TRUE,
control = list(trace = FALSE),
data = healthsurvey)

# print the model:
coef(model3, aslist = TRUE)$latent.params

# compare fit of model1 and model 3
# Likelihood Ratio Test
anova(model1, model3)

# AIC
AIC(model1, model3)

# Example 4 -----

# model with overdispersion
model4 <- hopit(latent.formula = health ~ hypertension + high_cholesterol +
        heart_attack_or_stroke + poor_mobility + very_poor_grip +
        depression + respiratory_problems +
        IADL_problems + obese + diabetes + other_diseases,
thresh.formula = ~ sex + ageclass + country,
overdispersion = TRUE,
decreasing.levels = TRUE,
control = list(trace = FALSE),
data = healthsurvey)

# estimated variance of the error term:
getTheta(model4)

# compare fit of model1 and model4
# Likelihood Ratio Test

```

```
print(anova(model1, model4), short = TRUE)
```

latentIndex	<i>Calculate latent index</i>
-------------	-------------------------------

Description

Calculate latent index from the latent variable. It takes values from 0 to 1, where zero is prescribed to the worse predicted state (maximal observed value for the latent variable) and 1 is prescribed to the best predicted health (minimal observed value for the latent variable).

Usage

```
latentIndex(model, decreasing.levels = TRUE, subset = NULL, plotf = FALSE,
  response = c("data", "fitted", "Jurges"), ylab = "Latent index", ...)
```

```
healthIndex(model, decreasing.levels = TRUE, subset = NULL, plotf = FALSE,
  response = c("data", "fitted", "Jurges"), ylab = "Latent index", ...)
```

Arguments

model	a fitted hopit model.
decreasing.levels	logical indicating if self-reported (e.g. health) classes are ordered in decreasing order.
subset	an optional vector specifying a subset of observations.
plotf	logical indicating if to plot summary figure.
response	X axis plotting option, choose 'data' for raw responses and 'fitted' for model reclassified responses
ylab	a label of y axis.
...	further parameters passed to the plot function.

Value

a vector with latent index for each individual.

Author(s)

Maciej J. Danko

References

\insertRefJurges2007hopit

See Also

[standardizeCoef](#), [getCutPoints](#), [getLevels](#), [hopit](#).

Examples

```

# DATA
data(healthsurvey)

# the order of response levels is decreasing (from the best health to the worst health)
levels(healthsurvey$health)

# Example 1 -----

# fitting a model
modell <- hopit(latent.formula = health ~ hypertension + high_cholesterol +
               heart_attack_or_stroke + poor_mobility + very_poor_grip +
               depression + respiratory_problems +
               IADL_problems + obese + diabetes + other_diseases,
               thresh.formula = ~ sex + ageclass + country,
               decreasing.levels = TRUE,
               control = list(trace = FALSE),
               data = healthsurvey)

# calculate health index and plotting reported health status
# vs. health index.
hi <- latentIndex(modell, plotf = TRUE, response = "data",
                  ylab = 'Health index', col='deepskyblue3')

# a simple histogram of the function output
hist(hi)

# calculate health index and plotting adjusted health status (Jurges 2007)
# vs. health index.
latentIndex(modell, plotf = TRUE, response = "Jurges",
            ylab = 'Health index', col='deepskyblue3')

# calculate health index and plotting predicted health status
# vs. health index.
latentIndex(modell, plotf = TRUE, response = "fitted",
            ylab = 'Health index', col='deepskyblue3')

```

my.grad

INTERNAL: numerical gradient

Description

INTERNAL: numerical gradient

Usage

```
my.grad(fn, par, eps, ...)
```

Arguments

<code>fn</code>	function.
<code>par</code>	parameters
<code>eps</code>	epsilon.
<code>...</code>	other parameters passed to <code>fn</code>

Author(s)

Maciej J. Danko

<code>standardizeCoef</code>	<i>Standardization of coefficients</i>
------------------------------	--

Description

Calculate standardized coefficients - disability weights computed as the latent coefficients from the generalised ordered probit model divided by the maximum possible range of its linear prediction. The range is calculated as difference between maximum and minimum possible value of the latent variable given estimated parameters.

Usage

```
standardizeCoef(model, ordered = TRUE, plotf = FALSE, plotpval = FALSE,
  mar = c(15, 4, 1, 1), oma = c(0, 0, 0, 0), YLab = "Disability weight",
  YLab.cex = 1.1, namesf = identity, ...)
```

```
standardiseCoef(model, ordered = TRUE, plotf = FALSE, plotpval = FALSE,
  mar = c(15, 4, 1, 1), oma = c(0, 0, 0, 0), YLab = "Disability weight",
  YLab.cex = 1.1, namesf = identity, ...)
```

```
disabilityWeights(model, ordered = TRUE, plotf = FALSE, plotpval = FALSE,
  mar = c(15, 4, 1, 1), oma = c(0, 0, 0, 0), YLab = "Disability weight",
  YLab.cex = 1.1, namesf = identity, ...)
```

Arguments

<code>model</code>	a fitted <code>hopit</code> model.
<code>ordered</code>	logical indicating if to order the disability weights.
<code>plotf</code>	logical indicating if to plot results.
<code>plotpval</code>	logical indicating if to plot p-values.
<code>mar, oma</code>	see par .
<code>YLab, YLab.cex</code>	label and size of the label for y axis.
<code>namesf</code>	a vector of names of coefficients or one argument function that modifies names of coefficients.
<code>...</code>	arguments passed to boxplot .

Value

a vector with standardized coefficients.

Author(s)

Maciej J. Danko

References

\insertRefJurges2007hopit

See Also

[latentIndex](#), [getCutPoints](#), [getLevels](#), [hopit](#).

Examples

```
# DATA
data(healthsurvey)

# the order of response levels is decreasing (from the best health to the worst health)
levels(healthsurvey$health)

# Example 1 -----

# fitting a model
modell1 <- hopit(latent.formula = health ~ hypertension + high_cholesterol +
  heart_attack_or_stroke + poor_mobility + very_poor_grip +
  depression + respiratory_problems +
  IADL_problems + obese + diabetes + other_diseases,
  thresh.formula = ~ sex + ageclass + country,
  decreasing.levels = TRUE,
  control = list(trace = FALSE),
  data = healthsurvey)

# A function that modifies coefficient names.
txtfun <- function(x) gsub('_', ' ', substr(x, 1, nchar(x)-3))

# Calculate and plot disability weights
sc <- standardizeCoef(modell1, plotf = TRUE, namesf = txtfun)
sc
```


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