

Package ‘crov’

October 12, 2022

Type Package

Title Constrained Regression Model for an Ordinal Response and Ordinal Predictors

Version 0.2.0

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Description Fits a constrained regression model for an ordinal response with ordinal predictors and possibly others, Espinosa and Hennig (2019) <[doi:10.1007/s11222-018-9842-2](https://doi.org/10.1007/s11222-018-9842-2)>. The parameter estimates associated with an ordinal predictor are constrained to be monotonic. If a monotonicity direction (isotonic or antitonic) is not specified for an ordinal predictor by the user, then the monotonicity direction classification procedure establishes it. Two monotonicity tests are also available to test the null hypothesis of monotonicity over a set of parameters associated with an ordinal predictor.

License GPL-2

Encoding UTF-8

LazyData TRUE

Imports VGAM (>= 1.0-5), gtools (>= 3.5.0), stats (>= 3.4.3)

RoxygenNote 7.0.1

NeedsCompilation no

Repository CRAN

Date/Publication 2020-04-09 18:20:02 UTC

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crovData	<i>Real data example</i>
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Description

Uses real data

Usage

crovData

Format

Data frame with 9 variables

mdcp	<i>Monotonicity Direction Classification (MDC) procedure</i>
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Description

Fits a constrained regression model for an ordinal response with ordinal predictors and possibly others, Espinosa and Hennig (2019) <<https://doi.org/10.1007/s11222-018-9842-2>>. The parameter estimates associated with an ordinal predictor are constrained to be monotonic. If a monotonicity direction (isotonic or antitonic) is not specified for an ordinal predictor by the user, then the monotonicity direction classification procedure establishes it.

Usage

```
mdcp(  
  formula,  
  data = NULL,  
  tryAllMonoDir = FALSE,  
  monoDir = NULL,  
  CLS1 = 0.95,  
  TLBS2 = 0.85,  
  TLNS2 = 0.999,  
  StepSizeCLS2 = 1e-04,  
  method = NULL,  
  monoTestSignLevel = 0.05  
)
```

Arguments

formula	A formula to be fitted with ordinal response, one or more ordinal predictors, and possibly one or more other predictors. For ordinal response and ordinal predictors use ordered factors.
data	A data.frame, list or environment (or object coercible by <code>as.data.frame</code> to a data.frame), containing the variables in formula. Neither a matrix nor an array will be accepted.
tryAllMonoDir	A logical value that indicates whether one model should be fitted for each one of the possible combinations of monotonicity directions. Use TRUE if none monotonicity direction is pre-specified using <code>monoDir</code> and the MDC procedure is not used.
monoDir	Vector with monotonicity directions for the ordinal predictors to be used as constraints. Possible values for <code>monoDir</code> are TRUE and FALSE. Use TRUE for "isotonic" and FALSE for "antitonic". The order of the elements in <code>monoDir</code> must be the same as the order of the ordinal predictors in the object <code>formula</code> , i.e., the <i>j</i> -th element of <code>monoDir</code> must correspond to the monotonicity direction of the <i>j</i> -th ordinal predictor in <code>formula</code> . If <code>tryAllMonoDir</code> and <code>monoDir</code> are not used (default option), the monotonicity direction classification procedure is executed to find the monotonicity directions associated to the model with the maximum log-likelihood.
CLS1	Numerical value for the confidence level to be used in the first step of the MDC procedure. This parameter is active if <code>tryAllMonoDir</code> and <code>monoDir</code> are not used.
TLBS2	Numerical value for the tolerance level to be used in the second step of the MDC procedure over those ordinal predictors classified as "Both" in the first step. This parameter is active if <code>tryAllMonoDir</code> and <code>monoDir</code> are not used.
TLNS2	Numerical value for the tolerance level to be used in the second step of the MDC procedure over those ordinal predictors classified as "None" in the first step. This parameter is active if <code>tryAllMonoDir</code> and <code>monoDir</code> are not used.
StepSizeCLS2	Numerical value for the magnitude in which the confidence levels will be increased or decreased during the second step of the MDC procedure. This parameter is active if <code>tryAllMonoDir</code> and <code>monoDir</code> are not used.
method	The type of constrained method to be used among "MDCS1", "MDCS2", "MDCS3", "CMLEbonferroni", "CMLEconfReg", and "CMLEfiltered". Default value corresponds to "MDCS3".
monoTestSignLevel	Significance level used when method is "CMLEbonferroni" or "CMLEconfReg". Default value 0.05.

Value

MDCproc: Data frame with the monotonicity direction classification (Isotonic, Antitonic, Both, or None) used for each ordinal predictor in each one of the steps of the MDC procedure (S1, S2 and S3), together with their individual confidence levels (CL). If `monoDir` is used, MDCproc shows the monotonicity directions in `monoDir`.

estimates: Vector of parameter estimates of the model.

estimates_se: Vector of standard errors of the parameter estimates of the model.

log.lik: Value of the log-likelihood of the model.

allModels: Data frame with monotonicity directions, log-likelihood and parameter estimates of all models involved in the third step of the MDC procedure. If parameter monoDir is used, allModels shows these results from the model with monotonicity directions used in monoDir only. If parameter tryAllMonoDir is used, allModels shows these results from all the models according to all possible combinations of monotonicity directions.

constrOptimRes: List with the outcomes provided by the function [constrOptim](#).

UMLE: Vector with the parameter estimates of the unconstrained version of the model.

UMLE_SE: Vector with the standard errors of the unconstrained version of the model.

References

Espinosa, J., Hennig, C. A constrained regression model for an ordinal response with ordinal predictors. *Stat Comput* 29, 869-890 (2019). <https://doi.org/10.1007/s11222-018-9842-2>.

See Also

[monoTestBonf](#), [monoTestConfReg](#), [constrOptim](#).

Examples

```
# Ordinal predictors: EduLevel, IncQuint, Health,
# Overcrowd, and NumChildren
# mdcExample <- mdc(QoL ~ EduLevel + Age + IncQuint + Gender + Health +
# Overcrowd + Activity + NumChildren, data = crowData,
# CLS1 = 0.95, TLBS2 = 0.90, TLNS2 = 0.99, StepSizeCLS2 = 0.0002)
# mdcExample$MDCproc
# cbind("CMLE"=mdcExample$estimates, "UMLE"=mdcExample$UMLE)
# mdcExample$UMLE_SE
# mdcExample$log.lik
# mdcExample$allModels[1:6]
```

monoTestBonf

Monotonicity test using Bonferroni correction

Description

Tests the null hypothesis of monotonicity over a set of parameters associated to an ordinal predictor.

Usage

```
monoTestBonf(simultAlpha = 0.05, OP_UMLE, OP_SE)
```

Arguments

simultAlpha	Numerical value for the simultaneous significance level.
OP_UMLE	Vector with the unconstrained parameter estimates of an ordinal predictor's categories represented by dummy variables in an unconstrained model for ordinal response (see vlgm).
OP_SE	Vector with the standard error of the parameters of an ordinal predictor's categories represented by dummy variables in an unconstrained model for ordinal response (see vlgm).

Value

testRes: String value with outcomes either "Reject H_0" or "Not Reject H_0".

simultAlpha: Numerical value with the simultaneous significance level.

indivAlphaA: Numerical value with the individual significance level for each confidence interval.

simultPvalue: Numerical value with the p-value associated to the simultaneous significance level.

References

Espinosa, J., Hennig, C. A constrained regression model for an ordinal response with ordinal predictors. *Stat Comput* 29, 869-890 (2019). <https://doi.org/10.1007/s11222-018-9842-2>.

See Also

[mdcp](#), [monoTestConfReg](#), [vlgm](#).

Examples

```
monoTestBonf(simultAlpha=0.05, OP_UMLE = c(0.256116, -0.5058427, 1.5799115),
OP_SE = c(0.229569, 0.6948236, 0.4059133))
```

monoTestConfReg

Monotonicity test using confidence regions

Description

Tests the null hypothesis of monotonicity over a set of parameters associated to an ordinal predictor.

Usage

```
monoTestConfReg(formula, data = NULL, SignifLevel = 0.05)
```

Arguments

formula	A formula to be fitted with ordinal response, one or more ordinal predictors, and possibly one or more other predictors. For ordinal response and ordinal predictors use ordered factors.
data	A data.frame, list or environment (or object coercible by <code>as.data.frame</code> to a data.frame), containing the variables in formula. Neither a matrix nor an array will be accepted.
SignifLevel	Numerical value for the significance level.

Value

resConfRegTest: Data frame with columns: OPName=Name of the ordinal predictor (OP), Num_Cat=Number of categories of the OP, UMLE_logLik=log-likelihood of the unconstrained model, CMLE_logLik=log-likelihood of the constrained model using `mdcp` assuming monotonicity for each OP, degreesOfFreedom=degrees of freedom used in the hypothesis test, Statistic=value of the statistic, CritValue=critical value resulting from the statistic, SignifLevel=significance level used in the test, P.Value=p-value, RejectMonotonicity=TRUE if the null hypothesis of monotonicity is rejected, FALSE otherwise.

See Also

[mdcp](#), [monoTestBonf](#), [vlgm](#).

Examples

```
# Ordinal predictors: EduLevel, IncQuint, Health,  
# Overcrowd, and NumChildren  
# monoTestConfRegExample <- monoTestConfReg(QoL ~ EduLevel + Age + IncQuint + Gender +  
# Health + Overcrowd + Activity + NumChildren, data = crowData, SignifLevel = 0.05)  
# monoTestConfRegExample$resConfRegTest
```

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