Package ‘lacm’

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Title Latent Autoregressive Count Models
Description Perform pairwise likelihood inference in latent autoregressive count models. See Pedeli and Varin (2020) for details.
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CLIC  Composite Likelihood Information Criterion

Description

Calculates the composite likelihood information criterion for a latent autoregressive count model fitted through maximum pairwise likelihood.
Usage

CLIC(object, ...)

Arguments

object  
a fitted model object of class "lacm".
...
optional arguments.

Details

Function CLIC computes the composite likelihood information criterion (Varin and Vidoni, 2005) for a latent autoregressive count model estimated by maximum pairwise likelihood. See Pedeli and Varin (2020) for details.

When comparing models fitted by maximum pairwise likelihood to the same data, the smaller the CLIC, the better the fit.

Value

a numeric value with the corresponding CLIC.

Author(s)

Xanthi Pedeli and Cristiano Varin.

References


See Also

lacm.

Examples

data("polio", package = "lacm")
## model components
trend <- 1:length(polio)
sin.term <- sin(2 * pi * trend / 12)
cos.term <- cos(2 * pi * trend / 12)
sin2.term <- sin(2 * pi * trend / 6)
cos2.term <- cos(2 * pi * trend / 6)
## fit model with pairwise likelihood of order 1
mod1 <- lacm(polio ~ I(trend * 10^(-3)) + sin.term + cos.term + sin2.term + cos2.term)
CLIC(mod1)
Fitting Latent Autoregressive Count Models by Maximum Pairwise Likelihood

Description

Fits latent autoregressive count models by maximum pairwise likelihood.

Usage

lacm(formula, data, subset, offset, contrasts = NULL, start.theta = NULL, fixed, d = 1, kernel.type = c("Rectangular", "Trapezoidal"), fit = TRUE, gh.num = 20, reltol.opt = 1e-06, opt.method = c("BFGS", "Nelder-Mead"), maxit.opt = 1000, sandwich.lag = NULL, bread.method = c("Outer-product", "Hessian"), ...)

Arguments

- **formula**: an object of class "formula" (or one that can be coerced to that class): a symbolic description of the model to be fitted. The details of model specification are given under ‘Details’.
- **data**: an optional data frame, list or environment (or object coercible by as.data.frame to a data frame) containing the variables in the model. If not found in data, the variables are taken from environment(formula), typically the environment from which lacm is called.
- **subset**: an optional vector specifying a subset of observations to be used in the fitting process.
- **offset**: this can be used to specify an a priori known component to be included in the linear predictor during fitting. This should be NULL or a numeric vector of length equal to the number of cases. One or more offset terms can be included in the formula instead or as well, and if more than one is specified their sum is used. See model.offset.
- **contrasts**: an optional list. See the contrasts.arg of model.matrix.default.
- **start.theta**: optional numeric vector with starting values for the model parameters.
- **fixed**: optional numeric vector of the same length as the total number of parameters. If supplied, only NA entries in fixed will be varied.
- **d**: order of the pairwise likelihood. Defaults to 1.
- **kernel.type**: one of "Rectangular", "Trapezoidal" indicating the type of kernel weights to be used in the weighted pairwise likelihood specification. The default "Rectangular" corresponds to equal contribution from all pairs of observations that are distant apart up to lag d. Can be abbreviated.
- **fit**: a logical value indicating whether to compute the maximum pairwise likelihood estimates or not.
- **gh.num**: number of the Gauss-Hermite quadrature nodes. Defaults to 20.
- **reltol.opt**: relative convergence tolerance to be passed to optim. Defaults to 1e-6.
opt.method one of "BFGS" or "Nelder-Mead" indicating the optimization method to be passed to optim. Can be abbreviated. See optim for details.

maxit.opt the maximum number of iterations to be passed to optim. Defaults to 1000.

sandwich.lag the lag length used for computing the bandwidth of the sandwich variance. See 'Details'.

bread.method one of "Outer-product" or "Hessian" indicating whether the bread matrix of the sandwich variance is estimated with the outer-product of the individual gradients or with a numerical approximation of the Hessian matrix. Can be abbreviated. See 'Details'.

Details

Function lacm performs maximum pairwise likelihood estimation in latent autoressive count models, see Pedeli and Varin (2020) for details.

Evaluation of the pairwise likelihood is performed through double Gauss-Hermite quadrature with the gh.num nodes and weights calculated by gauss.quad.

Standard formula $y \sim x_1 + x_2$ indicates that the mean response is modelled as a function of covariates $x_1$ and $x_2$ through a log link function.

Starting values supplied by the user can be specified through start.theta. If start.theta=NULL, then starting values are obtained using the method-of-moments as discussed in Ng et al. (2011).

Sandwich standard errors that are robust to heteroscedasticity and autocorrelation (HAC-type) are computed. The "meat matrix" is estimated using a lag length equal to sandwich.lag. If sandwich.lag is NULL, then $L$ is set equal to $10 \times \log_{10}(n)$, where $n$ is the time series length and $d$ is the pairwise likelihood order. The "bread matrix" is computed with the average of outer products of the individual gradients (bread.matrix = "Outer-product") or with a numerical approximation of the Hessian (bread.method = "Hessian"). Details are given in Pedeli and Varin (2020).

Value

An object of class "lacm" with the following components:

- nobs the number of observations.
- p the number of regressors, including the intercept.
- d the order of the pairwise likelihood.
- npar the number of parameters.
- Y the response used.
- X the model matrix used for the mean response.
- offset the offset used.
- sandwich.lag the lag length used for the bandwidth of the HAC-type standard errors.
- fit logical. Was the model fitted or not?
- gh.num number of Gauss-Hermite nodes used.
- call the matched call.
terms the terms object used.
latent logical. Does the model include the latent part?
fixed the numeric vector indicating which parameters are constants.
ifree indexes of the free parameters.
kweights the kernel weights used.
start.theta the starting values.
objfun function computing the logarithm of the pairwise likelihood of order d.
grad function computing the gradient of the pairwise likelihood of order d.
gh Gauss-Hermite nodes and weights used.
opt.method a character string specifying the method argument passed to optim. The de-
  fault optimization routine is the quasi-Newton algorithm BFGS. See optim for
details.
convergence an integer code indicating convergence of the optimizer. See link{optim} for
details.
gh a list with components the Gauss-Hermite nodes and the weights used for ap-
  proximating the pairwise likelihood.
plik the maximum pairwise likelihood value.
theta the maximum pairwise likelihood estimate.
jacobian the jacobian of the individual pairwise likelihood terms.
outer-product logical. Was the bread matrix of the sandwich variance computed with the outer
  product of the individual scores?
H the bread matrix.
J the meat matrix.
vcov the variance-covariance matrix of the maximum pairwise likelihood estimate.
CLIC the composite likelihood information criterion.

Functions summary.lacm, coefficients and vcov.lacm can be used to obtain or print a summary
of the results, extract coefficients and their estimated variance-covariance matrix of the model fitted
by lacm.

Author(s)
Xanthi Pedeli and Cristiano Varin.

References
Ng, C., Joe, H., Karlis, D., and Liu, J. (2011). Composite likelihood for time series models with a
latent autoregressive process. Statistica Sinica, 21, 279–305.

See Also
CLIC.
Examples

data("polio", package = "lacm")

## model components

trend <- 1:length(polio)
sin.term <- sin(2 * pi * trend / 12)
cos.term <- cos(2 * pi * trend / 12)
sin2.term <- sin(2 * pi * trend / 6)
cos2.term <- cos(2 * pi * trend / 6)

## fit model with pairwise likelihood of order 1
mod1 <- lacm(polio ~ I(trend * 10^(-3)) + sin.term + cos.term + sin2.term + cos2.term)
mod1
summary(mod1)

## refit with d = 3
mod3 <- update(mod1, d = 3)
summary(mod3)

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**polio**

*Polio Time Series*

**Description**

Time series of Polio incidences in USA from 1970 to 1983.

**Usage**

data(polio)

**Format**

Time series of monthly Polio cases in USA from January 1970 to December 1983.

**Source**


**Examples**

data(polio, package = "lacm")
Methods for fitted latent autoregressive count model objects of class "lacm"

Usage

## S3 method for class 'lacm'
summary(object, ...)

## S3 method for class 'lacm'
print(x, digits = max(3L, getOption("digits") - 3L), ...)

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

## S3 method for class 'lacm'
vcov(object, ...)

## S3 method for class 'lacm'
simulate(object, nsim = 1, seed = NULL, ...)

Arguments

object, x               a fitted model object of class "lacm".
digits                 the number of significant digits to use when printing.
nsim                   number of response vectors to simulate. Defaults to 1.
seed                   an object specifying if and how the random number generator should be initialized ("seeded"). See simulate.
...                     additional optional arguments.

Value

The function summary.lacm returns an object of class "summary.lacm", a list of some components of the "lacm" object, plus

coefficients           a summary of the parameter estimates, standard errors, z-values and corresponding p-values.
clic                   the composite likelihood information criterion.

The function simulate.lacm returns a list of simulated responses.
The function print returns the call and coefficients, coef returns the estimated coefficients and vcov the corresponding variance-covariance matrix.
Author(s)

Xanthi Pedeli and Cristiano Varin.

References


See Also

CLIC.

Examples

data("polio", package = "lacm")
## model components
trend <- 1:length(polio)
sin.term <- sin(2 * pi * trend / 12)
cos.term <- cos(2 * pi * trend / 12)
sin2.term <- sin(2 * pi * trend / 6)
cos2.term <- cos(2 * pi * trend / 6)
## fit model with pairwise likelihood of order 1
mod1 <- lacm(polio ~ I(trend * 10^(-3)) + sin.term + cos.term + sin2.term + cos2.term)
mod1
summary(mod1)
## refit with d = 3
mod3 <- update(mod1, d = 3)
summary(mod3)
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