Package ‘ConsReg’

April 5, 2020

Type Package
Title Fits Regression & ARMA Models Subject to Constraints to the Coefficient
Version 0.1.0
Author Josep Puig Sallés
Maintainer Josep Puig <puigjos@gmail.com>
Description Fits or generalized linear models either a regression with Autoregressive moving-average (ARMA) errors for time series data. The package makes it easy to incorporate constraints into the model's coefficients. The model is specified by an objective function (Gaussian, Binomial or Poisson) or an ARMA order (p,q), a vector of bound constraints for the coefficients (i.e beta1 > 0) and the possibility to incorporate restrictions among coefficients (i.e beta1 > beta2). The references of this package are the same as 'stats' package for glm() and arima() functions. See Brockwell, P. J. and Davis, R. A. (1996, ISBN-10: 9783319298528). For the different optimizers implemented, it is recommended to consult the documentation of the corresponding packages.
License GPL-2 | GPL-3
Encoding UTF-8
LazyData true
Depends R (>= 3.5)
RoxygenNote 6.1.1
BugReports https://github.com/puigjos/ConsReg/issues
URL https://github.com/puigjos/ConsReg
Suggests testthat, knitr, rmarkdown
Imports data.table (>= 1.10), forecast (>= 8.0), rlang (>= 0.4), nloptr (>= 1.2), FME (>= 1.3), MCMCpack (>= 1.4), Rsolnp (>= 1.15), DOptim (>= 2.2), dfoptim, GA (>= 3.0), GenSA (>= 1.1), Metrics, ggplot2, adaptMCMC, Rcpp
VignetteBuilder knitr
**ConsReg**

Fit a regression model with gaussian or binomial objective function

### Description

ConsReg is a function that allows to estimate a regression model: linear regression (gaussian), logistic regression (binomial) or poisson regression. It allows the introduction of restrictions (both lower and upper limits) and restrictions between the coefficients (in the form, for example, of a>b).

### Usage

ConsReg(...)

```r
## Default S3 method:
ConsReg(x, y, family, optimizer, ini.pars.coef = NULL,
        constraints = NULL, LOWER = NULL, UPPER = NULL, penalty = 1000,
        ...)
```

```r
## S3 method for class 'formula'
ConsReg(formula, data = list(), optimizer = "solnp",
         family = c("gaussian", "binomial"), constraints = NULL,
         LOWER = NULL, UPPER = NULL, penalty = 1000,
         na.action = "na.omit", ini.pars.coef = NULL, ...)
```
Arguments

... additional parameters passed in the optimizer (number of iterations, ...)

x matrix of predictive variables

y vector of outcome variable

family a description of the error distribution and link function to be used in the model.
Possible values are: "gaussian" (linear regression) or "binomial" (logistic regression) and "poisson"

optimizer Optimizer package used for fit the model (include bayesian and genetic algorithm optimization). Possible values are: "solnp" (default) (Rsolnp), "gosonlp" (Rsolnp), "optim" (stats::optim), "nloptr" (nloptr), DEoptim ("DEoptim"), "dfoptim" (dfoptim), "mcmc" (FME::modMCMC), "MCMCmetrop" (MCMCpack::MCMCmetrop1R), "adaptMCMC" (adaptMCMC::MCMC), "GA" (GA package), "GenSA" (GenSA package)

ini.pars.coef vector of initial parameters. In case there is some constraint, then the ini.pars.coef should fulfill the constraints

constraints vector of constraints (see details)

LOWER (default NULL) vector of lower bounds for the coefficients. If the length of LOWER is not equal with the length of the coefficients, then, the rest will be equal to -Inf

UPPER (default NULL) vector of lower bounds for the coefficients. If the length of UPPER is not equal with the length of the coefficients, then, the rest will be equal to +Inf

penalty (default 1000) penalty to the objective function if some constraints do not fullfill

formula an object of class "formula" (or one that can be coerced to that class): a symbolic description of the model to be fitted

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 lm is called.

na.action na.action to the data

Details

Several optimizers of various R packages are implemented, including methods typically used in Bayesian regressions like Markov Chain Monte Carlo simulation.

Constraints will be a string: For example, if x1 and x2 are two coefficient names, then a constraint could be: "x1 > x2" or "x1+x2 > 2". For some constraints, one can write: "x1+x2>2, x1 > 1". Each constraint will be separate by commas.

Important: if there are some constraints that do not fulfill in a model without those constraints, it is recommended to use ini.pars.coef parameter to set initial values that fulfill constraints. See the example
Value

An object of class "ConsReg".

- **coefficients**: Coefficients of the regression
- **hessian**: Hessian matrix if the optimizer can return it
- **family**: Model family function
- **optimizer**: Optimizer object return (see details of each optimization package)
- **optimizer.name**: Name of the optimizer
- **df**: `nrow(data)` - number of coefficients
- **rank**: Number of coefficients
- **residuals**: Residuals of the model
- **fitted**: Fitted values of the model
- **metrics**: Accuracy metrics of the model
- **call**: The matched call
- **y**: Objective variable
- **x**: Regressors
- **formula**: Formula term
- **family.name**: Name of the family used

Author(s)

Josep Puig Sallés

Examples

data('fake_data')
fit1 = ConsReg(formula = y~x1+x2+x3+ I(x3^2) + x4, family = 'gaussian',
               optimizer = 'mcmc',
               data = fake_data)
summary(fit1)

# We impose constraints to x3 and x3^2 and x4
fit2 = ConsReg(formula = y~x1+x2+x3+ I(x3^2) + x4, data = fake_data,
               family = 'gaussian',
               constraints = '(x3 + I(x3^2)) > .01, x4 < .2',
               optimizer = 'mcmc',
               ini.pars.coef = c(-1.65, .12, -.004, 0.1, 0.1, .15))

fit1$coefficients
fit2$coefficients
**ConsRegArima**

**Fit regression model with Arma errors to univariate time series**

**Description**

ConsRegArima is a function that allows to estimate a regression model with errors following an ARMA process (p,q). It allows the introduction of restrictions (both lower and upper limits) and restrictions between the coefficients (in the form, for example, of a>b). Largely a wrapper for the arima function in the stats package but easier to include regressors.

**Usage**

ConsRegArima(...)

```r
## Default S3 method:
ConsRegArima(x, y, order, seasonal, optimizer,
  LOWER = NULL, UPPER = NULL, penalty = 1000, constraints = NULL,
  ini.pars.coef, model_fit = NULL, ...)

## S3 method for class 'formula'
ConsRegArima(formula, data = list(),
  optimizer = c("solnp"), order = c(0, 0), seasonal = list(order =
  c(0, 0), period = NA), LOWER = NULL, UPPER = NULL, penalty = 1000,
  constraints = NULL, ini.pars.coef = NULL, na.action = "na.omit",
  ...
```

**Arguments**

- `...` additional parameters passed in the optimizer (number of iterations, ...)
- `x` matrix of predictive variables
- `y` vector of outcome variable
- `order` Arma component (p, q)
- `seasonal` A specification of the seasonal part of the ARMA model (P,Q), plus the period (which defaults to 1).
- `optimizer` Optimizer package used for fit the model (include bayesian and genetic algorithm optimization). Possible values are: "solnp" (default) (Rsolnp), "gosonlp" (Rsolnp), "optim" (stats::optim), "nloptr" (nloptr), DEoptim ("DEoptim"), "dfoptim" (dfoptim), "mcmc" (FME::modMCMC), "MCMCmetrop" (MCMCpack::MCMCmetrop1R), 'adaptMCMC'(adaptMCMC::MCMC), "GA" (GA package), "GenSA" (GenSA package)
- `LOWER` (default NULL) vector of lower bounds for the coefficients. If the length of LOWER is not equal with the length of the coefficients, then, the rest will be equal to -Inf
- `UPPER` (default NULL) vector of lower bounds for the coefficients. If the length of UPPER is not equal with the length of the coefficients, then, the rest will be equal to +Inf
penalty (default 1000) penalty to the objective function if some constraints do not fulfill
constraints vector of constraints (see details)
ini.pars.coef vector of initial parameters. In case there is some constraint, then the ini.pars.coef
should fulfill the constraints. This vector is only for regression component.
model_fit object of class ConsRegArima to update the Arma part and fix the coefficient
from a previous model
formula an object of class "formula" (or one that can be coerced to that class): a symbolic
description of the model to be fitted
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 lm is called.
na.action na.action to the data

Details

Several optimizers of various R packages are implemented, including methods typically used in
Bayesian regressions like Markov Chain Monte Carlo simulation.

Constraints will be a string: For example, if x1 and x2 are two coefficient names, then a constraint
could be: "x1 > x2" or "x1+x2 > 2". For some constraints, one can write: "x1+x2>2, x1 > 1". Each
constraint will be separate by commas.

Important: if there are some constraints that do not fulfill in a model without those constraints, it is
recommended to use ini.pars.coef parameter to set initial values that fulfill constraints. See the
example

On the other hand, aic value is computed as auto.arima function computes the AIC when method
== 'CSS':

\[ AIC = n \times \log(\sigma^2) + npar * 2 \]

Where npar I set the number of coefficients.

Value

An object of class "ConsRegArima".

coefficients Coefficients (regression + arma errors)
hessian hessian matrix if the optimizer can return it
optimizer optimizer object return (see details of each optimization package)
optimizer.name name of the optimizer
df nrow(data) - number of coefficients
rank number of coefficients
objective_function objective_function used
model A list representing the Kalman Filter used in the fitting
sigma2 the MLE of the innovations variance
fake_data 7

residuals residuals of the model
fitted fitted values of the model
fitted_regression fitted values only of the regression part
fitted_arima fitted values only of the arma part
metrics Accuracy metrics of the model (accuracy function of the forecast package)
call the matched call
y objective series
x regressors
formula formula term
aic the AIC value (see details)
bic the BIC value
aicc the AICc value

Author(s)
Josep Puig Salles

References

Examples
data('series')
fit1 = ConsRegArima(formula = y ~ x1+x2 +x3+x4,
     order = c(2, 1), data = series)
summary(fit1)
fit2 = ConsRegArima(formula = y ~ x1+x2 +x3+x4, order = c(2, 1),
     data = series, constraints = '(x3 +.1) > x1',
     ini.pars.coef = c(.96, .2, -.8, .4), UPPER = 1, LOWER = -1)

fit1$coefficients
fit2$coefficients

fake_data Fake data for regression

Description
Fake data to show gaussian model example
Usage

fake_data

Format

data

Examples

data('fake_data')

plot.roll.ConsRegArima

Plot an roll object plot an roll.ConsRegArima object

Description

Plot an roll object plot an roll.ConsRegArima object

Usage

## S3 method for class 'roll.ConsRegArima'
plot(x, ...)

Arguments

x      roll.ConsRegArima object
...
  Additional params passed to ggplot2::labs function

predict.ConsReg

Predict or fitted values of object ConsReg

Description

Predict or fitted values of object ConsReg

Usage

## S3 method for class 'ConsReg'
predict(object, newdata = NULL, components = F, ...)
predict.ConsRegArima

Arguments

- **object**: object of class ConsReg
- **newdata**: New data to predict the objective function. If is NULL (default), then the fitted values will be returned
- **components**: if its TRUE, it will return the predictions for each regression component
- **...**: Additional argument passed to family. In particular, at this moment, if type = 'link', then for binomial family, it will return the link values

Value

- **predictions**

Examples

```r
data('fake_data')
data = fake_data
data$y = 1/(1+exp(-data$y))
data$y = ifelse(data$y > .5, 1, 0)
table(data$y)

fit5 = ConsReg(y~x1+x2+x3+x4, data = data,
               family = 'binomial', penalty = 10000,
               LOWER = -.5, UPPER = .2,
               optimizer = 'gosolnp')
pr = predict(fit5, newdata = data[1:3,], type = 'probability')
pr
```

---

**predict.ConsRegArima**  
*Predict function for ConsRegArima object*

Description

Obtains predictions of ConsRegArima object

Usage

```r
# S3 method for class 'ConsRegArima'
predict(object, h = ifelse(is.null(newdata), 1, nrow(newdata)),
         newdata = NULL, intervals = 90, origdata = NULL,
         ...)  

# S3 method for class 'predict.ConsRegArima'
print(x, ...)  

# S3 method for class 'predict.ConsRegArima'
plot(x, ...)  
```
Arguments

object ConsRegArima object
h horizon to predict
newdata data frame in which to look for variables with which to predict. In case there is no regression part, this parameter could be set NULL
intervals Confidence level for prediction intervals (default 90)
origdata Original data (default NULL). Useful if lagged predictive variables are used in the formula
... Additional params passed to the function ggplot2::labs
x object of class predict.ConsRegArima

Value

Returns an object of class predict.ConsRegArima

predict dataframe with the predictions
table dataframe with the predictions as well as the fitted values
intervals Interval level
object original object

Description

Function for creating rolling density forecast from ConsRegArima models with option for refitting every n periods.

Usage

rolling(object, used.sample, refit, h = 1, orig.data, ...)

Arguments

object ConsRegArima object
used.sample The starting point in the dataset from which to initialize the rolling forecast.
refit Determines every how many periods the model is re-estimated. If refit=0, then no refit is doing
h The number of periods to forecast
orig.data data original which was used to estimate the ConsRegArima object
... Additional params for predict function
Value

results: data.frame with Real, Prediction, Prediction_High, Prediction_Low and fitted values of the object
refitT: how many periods the model is re-estimated
metrics: Main metrics of the predictions

See Also

plot.roll.ConsRegArima

Examples

data('series')
fit1 = ConsRegArima(formula = y ~ x1+x2 +x3, order = c(2, 1), optimizer = 'solnp', data = series)
roll = rolling(fit1, used.sample = 40, refit = 5, orig.data = series, h=3)
roll
plot(roll)

sales

Sales data set

Description

Sales data set for time series models

Usage

sales

Format

data

Examples

data('series')
series  

Fake data for time series

Description
Fake data to show Arima example

Usage
series

Format
data
Index

*Topic datasets
   fake_data, 7
   sales, 11
   series, 12

ConsReg, 2
ConsRegArima, 5

fake_data, 7

plot.predict.ConsRegArima
   (predict.ConsRegArima), 9
plot.roll.ConsRegArima, 8, 11
predict.ConsReg, 8
predict.ConsRegArima, 9
print.predict.ConsRegArima
   (predict.ConsRegArima), 9

rolling, 10

sales, 11
series, 12