Bias-reduced Logistic Regression

Description

Fits a logistic regression by maximum penalized likelihood, in which the penalty function is the Jeffreys invariant prior. This removes the $O(1/n)$ term from the asymptotic bias of estimated coefficients (Firth, 1993), and always yields finite estimates and standard errors (whereas the MLE is infinite in situations of complete or quasi-complete separation).

Usage

```r
brlr(formula, data = NULL, offset, weights, start, ..., subset,
     dispersion = 1, na.action = na.omit, contrasts = NULL,
     x = FALSE, br = TRUE, control = list(maxit = 200))
```
Arguments

- **formula**: a model formula as for `glm`, or an object of class `glm`.
- **data**: an data frame as for `glm`.
- **offset**: an optional vector as for `glm`.
- **weights**: an optional vector as for `glm`.
- **start**: an optional set of starting values (of the model coefficients) for the optimization.
- **...**: further arguments passed to or from other methods.
- **subset**: an optional vector specifying a subset of observations to be used in the fitting process.
- **dispersion**: an optional parameter for over- or under-dispersion relative to binomial variation — default is 1.
- **na.action**: a function which indicates what should happen when the data contain ‘NA’s. The default is set by the `na.action` setting of `options`, and is `na.fail` if that is unset. The “factory-fresh” default is `na.omit`.
- **contrasts**: an optional list. See the `contrasts.arg` of `model.matrix.default`.
- **x**: should the model matrix be included in the resultant object?
- **br**: a logical switch indicating whether the bias-reducing penalty is applied; default is `TRUE`.
- **control**: as for `optim`.

Details

`brlr` has essentially the same user interface as `glm(family=binomial, ...)` — see the example below.

Value

A model object of class `brlr`, with components

- **coefficients**: as for `glm`.
- **deviance**: as for `glm`.
- **penalized.deviance**: deviance minus 2*`logdet`(Fisher information).
- **fitted.values**: as for `glm`.
- **linear.predictors**: as for `glm`.
- **call**: as for `glm`.
- **formula**: as for `glm`.
- **convergence**: logical, did the optimization converge?
- **niter**: number of iterations of the optimization algorithm (BFGS via `optim`).
- **df.residual**: as for `glm`.
- **df.null**: as for `glm`.
- **model**: as for `glm`.
- **y**: the observed binomial proportions, as for `glm`.
family a family object, binomial with logistic link, as for \texttt{glm}
offset as for \texttt{glm}
prior.weights as for \texttt{glm}
terms as for \texttt{glm}
dispersion as for \texttt{glm}; the dispersion argument if supplied, otherwise 1
bias.reduction logical, the value of argument \texttt{br}
leverages the diagonal elements of the model’s “hat” matrix
qr as for \texttt{glm}
rank as for \texttt{glm}
FisherInfo the estimated Fisher information matrix
contrasts as for \texttt{glm}
xlevels as for \texttt{glm}
residuals as for \texttt{glm}
data as for \texttt{glm}
boundary as for \texttt{glm}; but always FALSE
x if \texttt{x = TRUE} is specified
control the control list as used in the call to \texttt{optim}

\textbf{Note}

1. Methods specific to the \texttt{brlr} class of models are
   \begin{itemize}
   \item \texttt{print.brlr}
   \item \texttt{summary.brlr}
   \item \texttt{print.summary.brlr}
   \item \texttt{vcov.brlr}
   \item \texttt{add1.brlr}
   \item \texttt{drop1.brlr}
   \end{itemize}
   Others are inherited from the \texttt{glm} class.

2. The results of the bias-reduced fit typically have regression coefficients slightly closer to zero than the maximum likelihood estimates, and slightly smaller standard errors. (In logistic regression, bias reduction is achieved by a slight shrinkage of coefficients towards zero; thus bias reduction also reduces variance.) The difference is typically small except in situations of sparse data and/or complete separation. See also Heinze and Schemper (2002), Zorn (2005).

\textbf{Author(s)}

David Firth, \{d.firth@warwick.ac.uk\}

\textbf{References}

Examples

```r
# Habitat preferences of lizards, from McCullagh and Nelder (1989, p129);
# this reproduces the results given in Firth (1992).
#
# First the standard maximum-likelihood fit:
data(lizards)
glm(cbind(grahami, opalinus) ~ height + diameter + light + time,
   family = binomial, data=lizards)
#
# Now the bias-reduced version:
brlr(cbind(grahami, opalinus) ~ height + diameter + light + time,
   data=lizards)
```

Description

The `lizards` data frame has 23 rows and 6 columns. Variables `grahami` and `opalinus` are counts of two lizard species at two different perch heights, two different perch diameters, in sun and in shade, at three times of day.

Usage

```r
data(lizards)
```

Format

This data frame contains the following columns:

- `grahami` count of grahami lizards
- `opalinus` count of opalinus lizards
- `height` a factor with levels "<5ft", ">=5ft"
- `diameter` a factor with levels "<=2in", ">2in"
- `light` a factor with levels "sunny", "shady"
- `time` a factor with levels "early", "midday", "late"

Source


Originally from


Examples

```r
data(lizards)
glm(cbind(grahami, opalinus) ~ height + diameter + light + time,
   family = binomial, data=lizards)
```
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