The betareg Package

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Title Beta Regression.

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Author Alexandre de Bustamante Simas <alesimas@impa.br>, with contributions, in this last version, from Andréa Vanessa Rocha <andrea@cox.de.ufpe.br>

Description Beta regression for modeling rates and proportions.

Maintainer Alexandre de Bustamante Simas <alesimas@impa.br>

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anova.betareg

A preliminary version for the analysis of variance table

Description

Compute an analysis of variance table for one or two model fits.

Usage

anova.betareg(object, object2, ...)

Arguments

object  
a fitted model using betareg, if there are two models, then this model should be the restricted one
object2  
(optional) a fitted model using betareg
...
  further arguments passed to or from other methods.

Value

If object2 is missing, an anova table is produced considering the null that the model contain only the intercept. If object2 isn’t missing (i.e., a restricted model was placed), an anova table is produced considering the null that the second model is true. This “anova table” is constructed using the log-likelihood ratio test suggest by Ferrari and Cribari-Neto (2004).

Author(s)

Alexandre de Bustamante Simas, Instituto de Matemática Pura e Aplicada (alesimas@impa.br). Andréa Vanessa Rocha (andrea@cox.de.ufpe.br) contributed in the development of this function.

References


See Also

br.fit, summary.betareg, predict.betareg, residuals.betareg

Examples

data(pratergrouped)
fit1 <- betareg(oil ~ batch1 + batch2 + batch3 + batch4 + batch5 + batch6 + batch7 + batch8 + batch9 + temp, data=pratergrouped)
fit2 <- betareg(oil ~ batch1 + batch2 + temp, data=pratergrouped)
## With only one model
anova(fit1)
## With two models, note that the first model is the restricted one.
anova(fit2, fit1)
Fitting beta regression models

Description

'betareg' is used to fit a regression model where the response is beta distributed using a parameterization of the beta law that is indexed by mean and dispersion parameters.

Usage

betareg(formula, link = "logit", data)

Arguments

formula  a symbolic description of the model to be fit: response covariates.
link     a link function; the following links are available: logit, probit and cloglog. The default link function is logit.
data     the 'data argument': a data frame containing the data.

Details

The model is useful for situations where the variable of interest is continuous, restricted to the standard unit interval (0,1), and related to other variables through a regression structure. The regression parameters of the beta regression model are interpretable in terms of the mean of the response and, when the logit link is used, of an odds ratio, unlike the parameters of a linear regression that employs a transformed response. Estimation is performed by maximum likelihood. The log-likelihood function is maximized using the quasi-Newton BFGS algorithm with analytical first derivatives; the choice of initial values follows the proposal made by Ferrari and Cribari-Neto (2004).

Value

The function returns an object of class 'betareg' or 'lm'. The function 'summary' is used to obtain an estimate of the precision parameter (phi), and the pseudo R2 value.

Author(s)

Alexandre de Bustamante Simas, Instituto de Matemática Pura e Aplicada (alesimas@impa.br).

References


See Also

br.fit, summary.betareg, predict.betareg, residuals.betareg
Examples

data(pratergrouped)
fit1 <- betareg(oil ~ batch1 + batch2 + batch3 + batch4 + batch5 +
batch6 + batch7 + batch8 + batch9 + temp, data=pratergrouped)
fit2 <- betareg(oil ~ batch1 + batch2 + batch3 + batch4 + batch5 + batch6 +
batch7 + batch8 + batch9 + temp, link = "probit", data=pratergrouped)
summary(fit1)
par(mfrow=c(2,2))
plot(fit1)

---

**br.fit**

*Function to estimate the coefficients of the Beta Regression.*

**Description**

Function to estimate the coefficients of the Beta Regression.

**Usage**

`br.fit(x, y, link)`

**Arguments**

- `x` : the terms matrix
- `y` : the response matrix
- `link` : an object returned by the `make.link` function.

**Value**

The function returns the estimated coefficients of the regression, the estimation of the precision parameter phi, the fitted values, the residuals, the pseudo R2, the standard errors, the critical values of the normal distribution and the p-values of each coefficient and the phi parameter.

**Author(s)**

Alexandre de Bustamante Simas, Instituto de Matemática Pura e Aplicada (alesimas@impa.br).

**References**


**See Also**

`betareg`, `summary.betareg`, `predict.betareg`, `residuals.betareg`

**Examples**

```r
x <- cbind(rnorm(10),rnorm(10))
y <- cbind(rbeta(10,1,1))
link = betareg(y ~ x)$funlink
br.fit(x,y,link)
```
Description

Compute the Cook’s distance values for beta regression models.

Usage

```r
cooks.distance.betareg(model, ...)
```

Arguments

- `model`: a fitted model using `betareg`.
- `...`: further arguments passed to or from other methods.

Value

This function returns a vector containing the Cook’s distance values.

Author(s)

Alexandre de Bustamante Simas, Instituto de Matemática Pura e Aplicada (alesimas@impa.br).

References


See Also

- `br.fit`, `summary.betareg`, `predict.betareg`, `residuals.betareg`

Examples

```r
data(pratergrouped)
fit <- betareg(oil ~ batch1 + batch2 + batch3 + batch4 + batch5 + batch6 + batch7 + batch8 + batch9 + temp, data=pratergrouped)
cooks.distance(fit)
```
df.residual.betareg

Residual Degrees-of-Freedom

Description

Returns the residual degrees-of-freedom extracted from a fitted betareg model object.

Usage

df.residual.betareg(object, ...)

Arguments

object  an object for which the degrees-of-freedom are desired.
...

further arguments passed to or from other methods.

Value

The value of the residual degrees-of-freedom extracted from the object 'x'.

Author(s)

Alexandre de Bustamante Simas, Instituto de Matemática Pura e Aplicada (alesimas@impa.br).

See Also

br.fit, summary.betareg, predict.betareg, residuals.betareg

Examples

data(pratergrouped)
fit <- betareg(oil ~ batch1 + batch2 + batch3 + batch4 + batch5 + batch6 + batch7 + batch8 + batch9 + temp, data=pratergrouped)
df.residual(fit)

envelope.beta

Half-Normal Plot of Standardized and Deviance Residuals

Description

Two plots are provided together with an envelope: A Half-Normal plot of standardized residuals and a Half-Normal plot of deviance residuals.

Usage

envelope.beta(model=fit.model,sim=100,conf=.90, pch="+",font.main=1, cex.main=1.5, type = c("standardized","deviance"))
### Arguments

- **model**: Fitted model using betareg
- **sim**: The number of simulations used to produce the confidence bounds
- **conf**: The confidence level
- **pch**: Determines if the points are presented as "+" or "-"
- **font.main**: Determines the type of the font in the main title
- **cex.main**: The size of the font in the main title
- **type**: Determines if the type of the residual is "standardized" or "deviance"

### Author(s)

Alexandre de Bustamante Simas, Instituto de Matemática Pura e Aplicada (alesimas@impa.br).
This function was made by Elias Krainski.

### References


### See Also

- `betareg`
- `summary.betareg`
- `predict.betareg`
- `residuals.betareg`

### Examples

```r
data(pratergrouped)
fit <- betareg(oil ~ batch1 + batch2 + batch3 + batch4 + batch5 +
batch6 + batch7 + batch8 + batch9 + temp, data=pratergrouped)
envelope.beta(fit)
```

---

### estfun.betareg

#### Extract Empirical Estimating Functions

### Description

Function for extracting the empirical estimating functions of a betareg fitted model.

### Usage

```r
estfun.betareg(x, ...)
```

### Arguments

- **x**: a fitted model using betareg.
- **...**: further arguments passed to or from other methods.

### Value

A matrix containing the empirical estimating functions. Typically, this should be an n x k matrix corresponding to n observations and k parameters. The columns should be named as in coef or terms, respectively.
Author(s)
Alexandre de Bustamante Simas, Instituto de Matemática Pura e Aplicada (alesimas@impa.br). This function was made by Achim Zeileis.

References

See Also
br.fit, summary.betareg, predict.betareg, residuals.betareg

Examples

data(pratergrouped)
fit <- betareg(oil ~ batch1 + batch2 + batch3 + batch4 + batch5 + batch6 + batch7 + batch8 + batch9 + temp, data=pratergrouped)
estfun.betareg(fit)

---

Description
Compute the generalized leverages values for beta regression models.

Usage

gen.lev.betareg(x, ...)

Arguments

x
a fitted model using betareg.

... further arguments passed to or from other methods.

Value
This function returns a vector containing the generalized leverage values. The generalized leverage was proposed by Wei, Hu and Fung and was adapted to the beta regression model by Ferrari and Cribari-Neto (2004).

Author(s)
Alexandre de Bustamante Simas, Instituto de Matemática Pura e Aplicada (alesimas@impa.br).

References
hatvalues.betareg

See Also

\texttt{br.fit, summary.betareg, predict.betareg, residuals.betareg}

Examples

data(pratergrouped)
fit <- betareg(oil ~ batch1 + batch2 + batch3 + batch4 + batch5 +
batch6 + batch7 + batch8 + batch9 + temp, data=pratergrouped)
gen.lev.betareg(fit)

hatvalues.betareg  \textit{Hat values}

Description

Compute the diagonal elements of the "Hat" matrix of a beta regression model.

Usage

\texttt{hatvalues.betareg(model, \ldots)}

Arguments

\begin{itemize}
\item \texttt{model}  a fitted model using betareg.
\item \texttt{\ldots}  further arguments passed to or from other methods.
\end{itemize}

Value

This function returns a vector containing the diagonal elements of the "hat" matrix.

Author(s)

Alexandre de Bustamante Simas, Instituto de Matemática Pura e Aplicada (alesimas@impa.br).

References


See Also

\texttt{br.fit, summary.betareg, predict.betareg, residuals.betareg}

Examples

data(pratergrouped)
fit <- betareg(oil ~ batch1 + batch2 + batch3 + batch4 + batch5 +
batch6 + batch7 + batch8 + batch9 + temp, data=pratergrouped)
hatvalues(fit)
logLik.betareg  

**Extract Log-Likelihood**

**Description**

Obtain the log-likelihood value of a fitted betareg model.

**Usage**

`logLik.betareg(object, ...)`

**Arguments**

- `object`  
  a fitted model using betareg.
- `...`  
  further arguments passed to or from other methods.

**Value**

Returns the log-likelihood value of the model together with the number of parameters.

**Author(s)**

Alexandre de Bustamante Simas, Instituto de Matemática Pura e Aplicada (alesimas@impa.br).

**References**


**See Also**

`br.fit`, `summary.betareg`, `predict.betareg`, `residuals.betareg`  

**Examples**

```r
data(pratergrouped)
fit <- betareg(oil ~ batch1 + batch2 + batch3 + batch4 + batch5 + batch6 + batch7 + batch8 + batch9 + temp, data=pratergrouped)
logLik(fit)
```
plot.betareg

Plot Diagnostics for an betareg Object

Description

This function returns four plots: a plot of residuals against fitted values, a plot of standardized residuals against fitted values, a generalized leverage plot against fitted values and a plot of Cook’s distances versus row labels.

Usage

plot.betareg(x, which = 1:4, caption = c("Deviance residuals vs indices of obs.", "Standardized residuals vs indices of obs.", "Generalized leverage vs. Predicted values", "Cook's distances plot"), panel = points, sub.caption = deparse(x$call), main = "", ask = prod(par("mfcol")) < length(which) && dev.interactive(), ..., id.n = 3, labels.id = names(residuals(x)), cex.id = 0.75)

Arguments

x Fitted model by betareg.
which If a subset of the plots is required, specify a subset of the numbers '1:4'.
caption Captions to appear above the plots.
panel Panel function. A useful alternative to 'points' is 'panel.smooth'.
sub.caption common title-above figures if there are multiple; used as 'sub' (s.'title') otherwise.
main title to each plot-in addition to the above 'caption'.
ask logical; if 'TRUE', the user is asked before each plot, see 'par(ask=.)'.
... optional arguments.
id.n number of points to be labelled in each plot, starting with the most extreme.
labels.id vector of labels, from which the labels for extreme points will be chosen. 'NULL' uses observation numbers.
cex.id magnification of point labels.

Author(s)

Alexandre de Bustamante Simas, Instituto de Matemática Pura e Aplicada (alesimas@impa.br).

References


See Also

betareg, br.fit, predict.betareg, residuals.betareg
prater

Examples

data(pratergrouped)
fit <- betareg(oil ~ batch1 + batch2 + batch3 + batch4 + batch5 + batch6 + batch7 + batch8 + batch9 + temp, data=pratergrouped)
plot(fit)

data(prater)
fit <- betareg(oil ~ apigrav + vaporpress + tempten + temp, data=prater)
plot(fit)

prater

Prater’s gasoline data

Description
Operational data of the proportion of crude oil converted to gasoline after distillation and fractionation.

Usage

data(prater)

Format
A data frame with 32 observations on 5 variables.

Details
This dataset was collected by Prater (1956), its dependent variable is the proportion of crude oil after distillation and fractionation. This dataset was analyzed by Atkinson (1985), who used the linear regression model and noted that there is “indication that the error distribution is not quite symmetrical, giving rise to some unduly large and small residuals” (p. 60).

Source

References

Examples

data(prater)
fit <- betareg(oil ~ apigrav + vaporpress + tempten + temp, data=prater)
plot(fit)
pratergrouped

pratergrouped  Grouped Prater’s gasoline data

Description
Operational data of the proportion of crude oil converted to gasoline after distillation and fractionation.

Usage
data(pratergrouped)

Format
A data frame with 32 observations on 11 variables. More details on the independent variables can be found in the details section below.


Details
The dataset contains 32 observations on the response and on the independent variables. It has been noted (Daniel and Wood, 1971, Ch. 8) that there are only ten sets of values of the first three explanatory variables which correspond to ten different crudes and were subjected to experimentally controlled distillation conditions. This dataset was analyzed by Atkinson (1985), who used the linear regression model and noted that there is “indication that the error distribution is not quite symmetrical, giving rise to some unduly large and small residuals” (p. 60). He proceeded to transform the response so that the transformed dependent variable assumed values on the real line, and then used it in a linear regression analysis.

The data were ordered according to the ascending order of the covariate that measures the temperature at which 10

Source

References

predict.betareg

Examples

data(pratergrouped)
fit1 <- betareg(oil ~ batch1 + batch2 + batch3 + batch4 + batch5 +
batch6 + batch7 + batch8 + batch9 + temp, data=pratergrouped)
fit2 <- betareg(oil ~ batch1 + batch2 + batch3 + batch4 + batch5 + batch6 +
batch7 + batch8 + batch9 + temp, link = "probit", data=pratergrouped)
plot(fit1)

predict.betareg Predicted values from beta regression model.

Description

This function returns predictions from a fitted betareg object.

Usage

predict.betareg(object, newdata = NULL, type = c("link", "response"), ... )

Arguments

object fitted model using betareg
newdata optionally, a data frame in which to look for variables with which to predict. If
 omitted, the fitted linear predictors are used.
type the type of prediction required. The default is on the scale of the linear predic-
tors; the alternative "response" is on the scale of the response variable.
... Optional arguments

Author(s)

Alexandre de Bustamante Simas, Instituto de Matemática Pura e Aplicada (alesimas@impa.br).
This version was modified to fit the standards of the 'lm' and 'glm' models. Andréa Vanessa Rocha
(andrea@cox.de.ufpe.br) helped in the development of this new function.

References


See Also

betareg, br.fit, summary.betareg, residuals.betareg

Examples

data(pratergrouped)
fit <- betareg(oil ~ batch1 + batch2 + batch3 + batch4 + batch5 +
batch6 + batch7 + batch8 + batch9 + temp, data=pratergrouped)
summary(fit)
new <- data.frame(x = cbind(0,1,1,0,1,0,1,1,201))
predict(fit)
predict(fit,new)
predict(fit,new,type="response")
Residuals function for beta regression models.

Description

This function returns the standardized residuals from beta regression models, deviance residuals or the raw residuals.

Usage

residuals.betareg(object, type=c("standardized", "raw", "deviance"), ...)

Arguments

object Fitted model using betareg.
type The desired type of residuals. This function returns by default the standardized residuals, also returns the deviance residuals and may return the raw residuals (which is the value minus estimated mean).
... Optional arguments

Author(s)

Alexandre de Bustamante Simas, Instituto de Matemática Pura e Aplicada (alesimas@impa.br).

References


See Also

betareg, br.fit, summary.betareg, predict.betareg

Examples

data(pratergrouped)
fit <- betareg(oil ~ batch1 + batch2 + batch3 + batch4 + batch5 + batch6 + batch7 + batch8 + batch9 + temp, data=pratergrouped)
residuals(fit)
residuals(fit, type="dev")
Summary method for Beta Regression

Description

'summary' method for class 'betareg'.

Usage

summary.betareg(object,...)

Arguments

object Fitted model using betareg
...
Optional arguments

Value

call the component from object
deviance residuals a summary of the deviance residuals, see residuals.betareg
coefficients a p by 4 matrix with the columns for the estimated coefficients, the std. errors, the critical values of a normal distribution and the corresponded p-values.
estimated phi the estimated value of the precision parameter together with its standard error.
null deviance the deviance from the model only containing the intercept (but, assuming the estimated phi from the current model)
residual deviance the deviance from the current model
log-likelihood ratio statistic the log-likelihood ratio statistic from the full model against the model containing only the intercept
Pseudo R2 the value of the pseudo R2 which is described by Ferrari and Cribari-Neto(2004).
AIC the corresponding AIC

Author(s)

Alexandre de Bustamante Simas, Instituto de Matemática Pura e Aplicada (alesimas@impa.br). This version was modified to fit the standards of the 'lm' and 'glm' models. Andréa Vanessa Rocha (andrea@cox.de.ufpe.br) helped in the development of this new function.

References


See Also

betareg,br.fit,predict.betareg,residuals.betareg
Examples

```r
data(pratergrouped)
fit <- betareg(oil ~ batch1 + batch2 + batch3 + batch4 + batch5 +
batch6 + batch7 + batch8 + batch9 + temp, data=pratergrouped)
summary(fit)
```

**vcov.betareg**

*Calculate Variance-Covariance Matrix for a betareg Fitted Model Object*

**Description**

Returns the variance-covariance matrix of the main parameters of a betareg fitted model object.

**Usage**

```r
vcov.betareg(object, ...)
```

**Arguments**

- `object` a fitted model using betareg.
- `...` further arguments passed to or from other methods.

**Value**

A matrix of the estimated covariances between the parameter estimates in the linear or non-linear predictor of the model.

**Author(s)**

Alexandre de Bustamante Simas, Instituto de Matemática Pura e Aplicada (alesimas@impa.br).
This function was inspired on the function made by Achim Zeileis.

**Examples**

```r
data(pratergrouped)
fit <- betareg(oil ~ batch1 + batch2 + batch3 + batch4 + batch5 +
batch6 + batch7 + batch8 + batch9 + temp, data=pratergrouped)
vcov(fit)
```
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