The BradleyTerry Package
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Title Bradley-Terry models
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URL http://www.warwick.ac.uk/go/dfirth
Description Specify and fit the Bradley-Terry model and structured versions
Depends R (>= 1.8.0), brlr
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Description

Extracts the abilities component from a model object of class BTm.

Usage

BTabilities(model)

Arguments

model a model object for which inherits(model, "BTm") is TRUE
Value

A two-column numeric matrix, with columns named "ability" and "se"; one row for each player.

Author(s)

David Firth

References


See Also

BTm, BTresiduals

Examples

data(citations)
origin <- factor(c("UK", "USA", "USA", "UK"))
citeModel2 <- BTm(citations ~ origin)
BTabilities(citeModel2)

---

BTm

**Bradley-Terry model and extensions**

Description

Fits Bradley-Terry models for pair comparison data, including models with structured scores, order effect and missing covariate data. Fits by either maximum likelihood or maximum penalized likelihood (with Jeffreys-prior penalty).

Usage

```
BTm(formula, refcat = NULL, offset = NULL, contrasts = NULL,
data = NULL, subset = NULL, br = FALSE, order.effect =
NULL, ...)
```

Arguments

- **formula**: A model formula for the Bradley-Terry “ability” parameters. Response variable should be a data frame containing contest results: columns include factors named "winner" (by default column 1) and "loser" (by default column 2), and possibly also "Freq", a numeric vector recording the frequency of each contest result (taken to be 1 if omitted). Variables on RHS have length equal to the number of players. The special RHS formula .. specifies the standard Bradley-Terry model with unstructured abilities.

- **refcat**: Character. Which is the “reference” player? Only used with .. on the RHS of the formula (otherwise ignored if supplied). Default is the name of the alphanumerically-first player.

- **offset**: An optional offset term in the model. A vector of length equal to the number of players.
contrasts  As for `glm`.

data       A data frame, in which RHS variables can be found.

subset    An optional logical or numeric vector specifying a subset of observations (ie, a subset of rows of the response dataframe) to be used in the fitting process.

br         Logical. If `TRUE`, fitting will be by penalized maximum likelihood as in Firth (1992, 1993), using `brlr` from package `brlr`. Default is fitting by maximum likelihood.

order.effect An optional vector, numeric, indicating an order effect to be estimated in the model (for example, a home advantage effect). Values should be 1 where contest winner has the advantage, -1 where loser has the advantage, and 0 where neither player is advantaged.

... Other arguments for `glm` or `brlr`

Details

No allowance is made for tied contests.

Aside from the possibility of an order effect, contest-specific predictors are not catered for by BTm. However, the availability of the `model` and `x` components in objects of class `BTm` allows a model fitted with only player-specific predictors to be manipulated subsequently to include further terms involving contest-specific predictors.

Value

An object of class c("BTm", "glm", "lm"). or of class c("BTm", "brlr", "glm", "lm") if `br = TRUE`. Components are as for glm or brlr, with additionally

x0          Model matrix for the formula as supplied (rather than the model matrix actually used in the subsidiary call to glm or brlr, which is included as component `x` if the call includes `x = TRUE`). One row for each player.

offset0    The supplied offset vector, if any was specified. One element for each player. (The offset vector actually used in the subsidiary call to glm or brlr is included as component `offset`.)

y0          The data frame of contest winners and losers, containing only those rows actually used in fitting the model.

order.effect The values of order.effect, if specified.

abilities   A two-column matrix of estimated abilities, with the ability for refcat set to zero if refcat is specified (otherwise the first player has zero ability). First column is estimated ability, second column is the standard error for that estimate. One row for each player.

Note

Methods specific to the BTm class of models are

- `add1.BTm`
- `drop1.BTm`
- `terms.BTm`
- `formula.BTm`

Others are inherited from glm or lm.
Author(s)

David Firth

References


See Also

`BTresiduals, BTabilites`

Examples

```r
## Statistics journal citation data from Stigler (1994)
## -- see also Agresti (2002, p448)
data(citations)

## First fit the "standard" Bradley-Terry model
print(citeModel <- BTm(citations ~ .))

## Now the same thing with a different "reference" journal
update(citeModel, . ~ ., refcat = "JASA")

## Is the "citeability" of a journal predicted by its country of origin?
origin <- factor(c("UK", "USA", "USA", "UK"))
print(citeModel2 <- BTm(citations ~ origin))

## Hmm... not so sure about the origin of "Comm Statist" ...
is.na(origin[2]) <- TRUE
citeModel2 <- update(citeModel2, . ~ .)

## Now an example with an order effect -- see Agresti (2002) p438
data(baseball)

## Simple Bradley-Terry model as in Agresti p437
print(baseballModel <- BTm(baseball ~ .))

## Introduce order effect as in Agresti p438
update(baseballModel, order.effect = baseball$home.adv)
```
BTresiduals

player-specific residuals from a Bradley-Terry model

Description

Computes player-specific residuals from a model object of class BTm, suitable for diagnostic checking of a predictor involving player-level covariates.

Usage

BTresiduals(model)

Arguments

model a model object for which inherits(model, "BTm") is TRUE

Details

The residuals returned by BTresiduals are weighted means of working residuals, with weights equal to the binomial denominators in the fitted model. These are suitable for diagnostic model checking, for example plotting against candidate predictors.

Value

A numeric vector of length equal to the number of players, with a "weights" attribute.

Author(s)

David Firth

References


See Also

BTm, BTabilities

Examples

data(citations)
origin <- factor(c("UK", "USA", "USA", "UK"))
citeModel2 <- BTm(citations ~ origin)
BTresiduals(citeModel2)
**Description**

Baseball results for games in the 1987 season between 7 teams in the Eastern Division of the American League.

**Usage**

data(baseball)

**Format**

A data frame with 98 observations on the following 4 variables.

- **winner** a factor with levels Milwaukee Detroit Toronto New York Boston Cleveland Baltimore
- **loser** a factor with levels Milwaukee Detroit Toronto New York Boston Cleveland Baltimore
- **Freq** a numeric vector
- **home.adv** a numeric vector

**Details**

The `home.adv` variable is 1 for games where the home team won, and -1 for games where the away team won.

**Source**


**References**


**See Also**

*BTm*

**Examples**

data(baseball)

```r
## The data in collapsed tabular form as on p438 of Agresti
xtabs(Freq ~ winner + loser, baseball)
## Simple Bradley-Terry model as in Agresti p437
print(baseballModel <- BTm(baseball ~ ..))
## Introduce order effect as in Agresti p438
update(baseballModel, order.effect = baseball$home.adv)
```
citations

Statistics journal citation data from Stigler (1994)

Description


Usage

data(citations)

Format

A data frame with 16 observations on the following 3 variables.

- **winner** a factor with levels Biometrika Comm Statist JASA JRSS-B
- **loser** a factor with levels Biometrika Comm Statist JASA JRSS-B
- **Freq** a numeric vector

Details

"winner" is the cited journal, "loser" the one doing the citing.

Source


References


See Also

- **BTm**

Examples

data(citations)
## Data as a square table, as in Agresti p448
xtabs(Freq ~ ., citations)
## Standard Bradley-Terry model fitted to these data
BTm(citations ~ ..)
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