

Package ‘eiCircles’

March 24, 2024

Type Package

Title Ecological Inference of RxC Tables by Overdispersed-Multinomial Models

Version 0.0.1-7

Description Estimates RxC (R by C) vote transfer matrices (ecological contingency tables) from aggregate data using the model described in Forcina et al. (2012), as extension of the model proposed in Brown and Payne (1986). Allows incorporation of covariates.

References:

Brown, P. and Payne, C. (1986). "Aggregate data, ecological regression and voting transitions". *Journal of the American Statistical Association*, 81, 453–460. <[DOI:10.1080/01621459.1986.10478290](https://doi.org/10.1080/01621459.1986.10478290)>.

Forcina, A., Gnaldi, M. and Bracalente, B. (2012). "A revised Brown and Payne model of voting behaviour applied to the 2009 elections in Italy". *Statistical Methods & Applications*, 21, 109–119. <[DOI:10.1007/s10260-011-0184-x](https://doi.org/10.1007/s10260-011-0184-x)>.

License GPL (>= 2)

Encoding UTF-8

Imports stats, NlcOptim (>= 0.6)

Suggests ggplot2, scales

RoxygenNote 7.1.1

NeedsCompilation no

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Repository CRAN

Date/Publication 2024-03-24 19:10:02 UTC

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BPF	<i>Ecological Inference of RxC Tables by Overdispersed-Multinomial Models</i>
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Description

Implements the model proposed in Forcina et al. (2012), as extension of Brown and Payne (1986), to estimate RxC vote transfer matrices (ecological contingency tables). Allows incorporation of covariates.

Usage

```
BPF(
  X,
  Y,
  local = "lik",
  covariates = NULL,
  census.changes = "adjust1",
  stable.units = TRUE,
  stability.par = 0.12,
  confidence = 0.95,
  cs = 50,
  null.cells = NULL,
  row.cells.relationships = NULL,
  row.cells.relationships.C = NULL,
  pair.cells.relationships = NULL,
  cells.fixed.logit = NULL,
  dispersion.rows = data.frame(row1 = rep(1L, ncol(X) - 1L), row2 = 2:ncol(X)),
  start.values = NULL,
  seed = NULL,
  max.iter = 100,
  tol = 1e-04,
  verbose = FALSE,
  save.beta = FALSE,
  ...
)
```

Arguments

X	matrix (or data.frame) of order KxR with either the electoral results recorded in election 1 or the sum across columns (the margins of row options) of the K ecological tables.
Y	matrix (or data.frame) of order KxC with either the electoral results recorded in election 2 or the sum across rows (the margins of column options) of the K ecological tables.

<code>local</code>	A character string indicating the algorithm to be used for adjusting the estimates of the transition probabilities obtained for the whole area (electoral space) with the actual observations available in each local unit. Only "IPF" (iterative proportional fitting, also known as raking), "lik" (an algorithm based on the assumed likelihood) and "none" are allowed. When <code>local = "none"</code> , no local estimates are obtained. Default, "lik".
<code>covariates</code>	A list with two components, <code>covar</code> and <code>meta</code> . <code>covar</code> is a matrix (or <code>data.frame</code>), of order $K \times NC$ (where K is the number of (polling) units and NC the number of covariates), with the values of the covariate(s) in each unit. <code>meta</code> is a matrix (or <code>data.frame</code>) with three columns. The data in these columns inform about the cell(s) (row and column) and covariate(s) that should be employed for modelling probabilities in each cell. Cell(s) and covariate(s) could be identified by position or names. For instance, (2, 3, "income") means that the covariate identified as "income" in the object <code>covar</code> should be used as covariate to model the probability corresponding to cell (2, 3) of the transfer (transition probability) matrix. Equally, ("party1", "party2", 4) means that the covariate located in the fourth column of <code>meta</code> should be used to model the transfer probability from "party1" to "party2", where "party1" (in X) and "party2" (in Y) are names used to identified columns in the election data objects. Default, <code>NULL</code> : no covariates are used.
<code>census.changes</code>	A string character indicating how census changes between elections must be handled. At the moment, it only admits two values "adjust1" and "adjust2", where the distributions of votes in election 1 or 2 are, respectively, adjusted to match the outcomes of the other election: "adjust1" adjusts the census of the first election to match that of the second one; "adjust2" adjusts the census of the second election to match that of the first one. Default, "adjust1".
<code>stable.units</code>	A TRUE/FALSE character indicating whether only stable units (those whose number of total number of voters have experienced a small change) are selected. Default, <code>TRUE</code> .
<code>stability.par</code>	A non-negative number that controls the maximum proportion of relative change in the total census for a unit to be considered stable. Default, 0.12. The relative change is measured as the absolute value of the difference of the logarithms of the sizes (censuses) in the two elections. Measuring the relative change this way avoids dependence on which election is used as reference.
<code>confidence</code>	A number between 0 and 1 to be used as level of confidence for the confidence intervals of the transition probabilities (TP estimates). Default, 0.95.
<code>cs</code>	A positive number indicating the average number of cluster size. Default, 50.
<code>null.cells</code>	A matrix (or <code>data.frame</code>) with two columns (row, column) informing about the cells whose probabilities should be constrained to be zero. Cells could be identified by position or names. For instance, (2, 3) means that the probability corresponding to cell (2, 3) of the transfer matrix should be constrained to be zero. Equally, ("party1", "party2") means that the transfer probability from "party1" (in X) to "party2" (in Y) will be zero, where "party1" and "party2" are names used to identified columns in the election data objects. Because the model takes the last option of Y as reference, constraints of this kind cannot be defined involving a cell of the reference category. See Note and Details for more infor-

mation about constraints and how properly define them. Default, NULL: no null constraints.

`row.cells.relationships`

A matrix (or `data.frame`) with four columns (`row`, `column1`, `column2`, `constant`) may be used to assign a pre-specified value to the ratio between the transition probabilities of two cells within the same row. Because the model takes the value in `column2` as reference to define this constraint, `column1` and `column2` must be different from the last column which has already been used to define the logits. Rows and columns could be identified by position or names. For instance, (2, 3, 5, 0.5) means that the probability corresponding to cell (2, 3) of the transfer matrix is constrained to be equal to 0.5 times the probability corresponding to cell (2, 5) of the transfer matrix. Because each cell defined by (`row`, `column2`) is used as reference relative to the corresponding cell (`row`, `column1`), it is removed and thus that cell cannot be reference within two different constraints. So, constraints involving the same cell should be defined with care. To be specific, the cells defined by (`row`, `columns2`) should not appear in other constraints. For instance, if in the *i*-th row you want constrain (cell 3) = (cell 1) x 0.6 and (cell 3) = (cell 2) x 0.3 you need to specify it as (cell 3) = (cell 1) x 0.6 and as (cell 2) = (cell 1) x 2. See Note and Details for more information about constraints and how properly define them.. Default, NULL: no row-cell constraints.

`row.cells.relationships.C`

A matrix (or `data.frame`) with three columns (`row`, `column`, `constant`) informing about the analog to the constraints described in `row.cells.relationships` when '`column2`' refers to the reference category (*C*-th column in *Y*). This is needed because logits are already computed with reference to column *C*, constraining these ratios is equivalent to assign a specified value to the logit in the corresponding cell. Rows and columns could be identified by position or names. For instance, (2, 3, 0.5) means that the probability corresponding to cell (2, 3) of the transfer matrix is constrained to be equal to 0.5 times the probability corresponding to cell (2, `ncol(Y)`) of the transfer matrix. See Note and Details for more information about constraints and how properly define them. Default, NULL: no row-proportional constraints.

`pair.cells.relationships`

This is a kind of less stringent version of the argument `row.cells.relationships`. Both may be used to increase or decrease a transition which is expected to be too different from informed expectations. This argument is declared via a matrix (or `data.frame`) with seven columns (`row1`, `column1.1`, `column1.2`, `row2`, `column2.1`, `column2.2`, `constant`) which imposes proportional relationships between ratios of probabilities corresponding to `row1` and `row2`. Let *r1* be the ratio between the probabilities in columns 1.1 and 1.2 in row 1, ' $r1 = \text{cell}(\text{row1}, \text{column1.1})/\text{cell}(\text{row1}, \text{column1.2})$ ', and *r2* the equivalent ration between probabilities in columns 2.1 and 2.2 in row2, ' $r2 = \text{cell}(\text{row2}, \text{column2.1})/\text{cell}(\text{row2}, \text{column2.2})$ ', then this argument is used to assign the specified value '`constant`' to ' $r2/r1$ '. Rows and columns could be identified by position or names. For instance, (2, 3, 5, 3, 4, 2, 0.5) means that the ratio of probabilities corresponding to cells (2, 3) and (2, 5) of the transfer matrix is constrained to be equal to 0.5 times the ratio of probabilities corresponding to cells (3, 4) and (3, 2) of the

	transfer matrix. See Note and Details for more information about constraints and how properly define them. Default, NULL: no ratio-proportional constraints.
<code>cells.fixed.logit</code>	A matrix (or <code>data.frame</code>) with three columns (<code>row</code> , <code>column</code> , <code>number</code>) informing about the cells with fixed values for the logit of the probability corresponding to the cell; this does not set the actual transition but its ratio with respect to the reference category. For instance, (2, 3, -5) means that the logit of the probability corresponding to cell (2, 3) of the transfer matrix is constrained to be -5. See Note and Details for more information about constraints and how properly define them. Default, NULL: no logit constraints.
<code>dispersion.rows</code>	A matrix (or <code>data.frame</code>) with two columns (<code>row1</code> , <code>row2</code>) indicating what pair of two rows should have equal overdispersions. Default, over-dispersions are assumed to be the same in all rows: <code>data.frame("row1" = rep(1L, ncol(X) - 1L), "row2" = 2:ncol(X))</code> . See Note and Details for more information about constraints and how properly define them. Use <code>dispersion.rows = NULL</code> to specify that overdispersion is unconstrained, i.e., that each row has a different parameter.
<code>start.values</code>	A vector of length $ncol(X) * ncol(Y) + nrow(meta) - NR$, where <code>nrow(meta)</code> accounts for the number of regression coefficients and <code>NR</code> is the number of restrictions imposed to either cell probabilities of the transition matrix or overdispersions through the arguments <code>cells.fixed.logit</code> , <code>row.cells.relationships</code> , <code>null.cells</code> , <code>row.cells.relationships.C</code> , <code>pair.cells.relationships</code> and <code>dispersion.rows</code> , with the initial estimates for (i) the logits of the transition matrix probabilities, taking the last column of <code>Y</code> as reference, (ii) the overdispersions (in the logit scale) and (iii) the coefficients in the regression models defined via <code>covariates</code> . Typically, this is a beta vector obtained from a previous run of BPF with the same specified model, but which abruptly stopped because of a break in the converging process (see the <code>save.beta</code> argument). Default, NULL. When <code>start = NULL</code> random initial values for the transition probabilities are generated assuming independence between origin and destination options (i.e., implying that transition probabilities are constant across rows), sound values for the over-dispersion parameters are generated and zero coefficients are assumed for the predictors of the regression models.
<code>seed</code>	A number indicating the random seed to be used. Default, NULL: no seed is used.
<code>max.iter</code>	Integer positive number. Maximum number of iterations to be performed for the Fisher scoring algorithm during the MLE estimation. Default, 100.
<code>tol</code>	Maximum value allowed for the numerical estimates of the partial derivatives of the likelihood in the point of convergence. Default, 0.0001.
<code>verbose</code>	A TRUE/FALSE character indicating whether intermediate results should be printed in the screen during the convergence process. Default FALSE.
<code>save.beta</code>	A TRUE/FALSE character indicating whether, while convergence is performed, the vector of temporary logits, over-dispersion (in logit scale) parameters and (if required) regression coefficients should be saved in the working directory in the file "beta.Rdata" file. This data could be used to restart the process in case of a premature failure of convergence process. Default FALSE.
<code>...</code>	Other arguments to be passed to the function. Not currently used.

Details

Description about how **defining constraints** in more detail.

To define constraints properly is a little tricky. Clearly, in the first place, it is the responsibility of the user to define constraints that are mutually compatible among themselves. The function does not check them to be jointly congruent. It is important to be aware that each linear constraint, when implemented, requires an element of the vector of internal parameters to be set to a known value and the corresponding element of the (underlying) design matrix to be removed. In addition, certain constraints are implemented by replacing one or more columns of the design matrix by suitable linear combinations of the columns that correspond to the cells involved in the constraint. A warning will be issued when two or more constraints require to remove the same column of the design matrix. To avoid conflicting constraints, a safe rule is that each constraint should be acting on disjoint sets of cells.

For each type of constraint, below we specify which column of the design matrix is removed and when a linear combination is needed how it is defined. Note that, in the unconstrained model, the design matrix has a column for each cell of the transition probabilities listed by row except for the last column which is used as reference:

- `null.cells`: The column of the design matrix corresponding to the cell defined by 'row' and column' declared when defining the constraint is removed.
- `row.cells.relationships`: The column of the design matrix corresponding to the cell (row, column2) is removed while the one corresponding to the cell (row, column2) is adjusted.
- `row.cells.relationships.C`: The column of the design matrix corresponding to the cell determined by each pair 'row', 'column' is removed.
- `pair.cells.relationships`: This constraint is defined by 4 pairs of "row, column"; the column of the design matrix corresponding to the last pair (row2, column2.2) will be removed and the others adjusted.

Value

A list with the following components

TM	The estimated RxC table (matrix) of transition probabilities/rates. This coincides with TP when <code>local = "none"</code> and is equal to TR when <code>local = "IPF"</code> or <code>local = "lik"</code> .
TM.votes	The estimated RxC table (matrix) of votes corresponding to TM.
TP	The estimated RxC table (matrix) of underlying transition probabilities obtained after applying the approach in Forcina et al. (2012) with the specified model.
TR	When <code>local = "IPF"</code> or <code>local = "lik"</code> , the estimated RxC table/matrix of transition rates obtained as composition of the estimated unit tables/matrices attained after adjusting TP in each polling unit to the unit margins using the iterative proportional fitting algorithm. When <code>local = "none"</code> , this object is 'NULL'.
TR.units	When <code>local = "IPF"</code> or <code>local = "lik"</code> , an array of order RxCxK with the tables/matrices of transition rates attained in each unit attained after adjusting TP using the iterative proportional fitting algorithm to the unit margins. When <code>local = "none"</code> , this object is 'NULL'.

TR.votes.units	When local = "IPF" or local = "lik", the array of order RxCxK with the tables/matrices of votes linked to the TR.units array. When local = "none", this object is 'NULL'.
TP.lower	A matrix of order RxC with the estimated lower limits of the confidence intervals, based on a normal approximation, of the underlying transition probabilities (TP) of the row-standardized vote transitions from election 1 to election 2.
TP.upper	A matrix of order RxC with the estimated upper limits of the confidence intervals, based on a normal approximation, of the underlying transition probabilities (TP) of the row-standardized vote transitions from election 1 to election 2.
beta	The estimated vector of internal parameters (logits) at convergence. The first R(C-1) - NR elements (where NR is the number of restrictions imposed in cell probabilities) are logits of transitions and the last nrow(meta) elements are the regression coefficients in case covariates are present. The over dispersion(s) parameter(s) is (are) in between. Default, just one over-dispersion parameter. In case of non-convergence, if the function is used with save.beta = TRUE, the components of beta from the file "beta.Rdata" and may be used to restart the algorithm from where it stopped by introducing them via the start.values argument.
overdispersion	The estimated vector at convergence of internal overdispersion parameters in the scale from 0 to 1.
sd.TP	Estimated standard deviations of the estimated transition probabilities.
sd.beta	The estimated standard errors of the elements of beta.
cov.beta	The estimated covariance matrix of beta. It may be used to compute approximate variances of transformations of the beta parameters, such as transition probabilities.
madis	A vector of length K with discrepancies of individual local units based on the Mahalanobis measure. It is essentially the quadratic discrepancy between observed and estimated votes weighted by the inverse of the estimated variance.
lk	The value of the log-likelihood at convergence.
selected.units	A vector with the indexes corresponding to the units finally selected to estimate the vote transition probability matrix.
iter	An integer number indicating the number of iterations performed before converging or when stopped.
inputs	A list containing all the objects with the values used as arguments by the function.

Note

Constraints may be used to force estimates to take values different from those obtained by unconstrained estimation. As such, these tools should be used sparingly and, essentially, to assess whether estimates are substantially (significantly) different from what we would expect or unexpected estimates are only due to random variation. To first order approximation, twice the difference between the unconstrained and the constrained log-likelihood should be distributed as a chi-square with 1 degree of freedom. This allows to test which constraints are in substantial conflict with the data.

Author(s)

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References

Brown, P. and Payne, C. (1986). Aggregate data, ecological regression and voting transitions. *Journal of the American Statistical Association*, 81, 453–460. doi:10.1080/01621459.1986.10478290

Forcina, A., Gnaldi, M. and Bracalente, B. (2012). A revised Brown and Payne model of voting behaviour applied to the 2009 elections in Italy. *Statistical Methods & Applications*, 21, 109–119. doi:10.1007/s102600110184x

Examples

```
votes1 <- structure(list(P1 = c(16L, 4L, 13L, 6L, 1L, 16L, 6L, 17L, 48L, 14L),
                        P2 = c(8L, 3L, 0L, 5L, 1L, 4L, 7L, 6L, 28L, 8L),
                        P3 = c(38L, 11L, 11L, 3L, 13L, 39L, 14L, 34L, 280L, 84L),
                        P4 = c(66L, 5L, 18L, 39L, 30L, 57L, 35L, 65L, 180L, 78L),
                        P5 = c(14L, 0L, 5L, 2L, 4L, 21L, 6L, 11L, 54L, 9L),
                        P6 = c(8L, 2L, 5L, 3L, 0L, 7L, 7L, 11L, 45L, 17L),
                        P7 = c(7L, 3L, 5L, 2L, 3L, 17L, 7L, 13L, 40L, 8L)),
                    row.names = c(NA, 10L), class = "data.frame")
votes2 <- structure(list(C1 = c(2L, 1L, 2L, 2L, 0L, 4L, 0L, 4L, 19L, 14L),
                        C2 = c(7L, 3L, 1L, 7L, 2L, 5L, 3L, 10L, 21L, 6L),
                        C3 = c(78L, 7L, 28L, 42L, 28L, 84L, 49L, 85L, 260L, 100L),
                        C4 = c(56L, 14L, 20L, 7L, 19L, 54L, 22L, 50L, 330L, 91L),
                        C5 = c(14L, 3L, 6L, 2L, 3L, 14L, 8L, 8L, 45L, 7L)),
                    row.names = c(NA, 10L), class = "data.frame")
example <- BPF(votes1, votes2, local = "IPF")$TM
```

plot.BPF

Graphical representation of a RxC ecological inference (vote transfer) matrix

Description

Plot method for objects obtained with BPF.

Usage

```
## S3 method for class 'BPF'
plot(
  x,
  margins = TRUE,
  digits = 2,
  row.names = NULL,
  col.names = NULL,
```

```

    size.numbers = 6,
    size.labels = 4,
    size.margins = 6,
    colour.cells = "darkolivegreen3",
    colour.grid = "floralwhite",
    alpha = 0.5,
    which = NULL,
    ...,
    show.plot = TRUE
)

```

Arguments

x	An object output of the BPF function.
margins	A TRUE/FALSE argument informing whether the margins of the matrix should be displayed. Default, TRUE.
digits	Integer indicating the number of decimal places to be shown. Default, 2.
row.names	Names to be used for the rows of the matrix.
col.names	Names to be used for the columns of the matrix.
size.numbers	A reference number indicating the average font size to be used for the transfer numbers. Default, 6.
size.labels	A number indicating the font size to be used for labels. Default, 4.
size.margins	A number indicating the font size to be used for margin numbers. Default, 6.
colour.cells	Background base colour for cells.
colour.grid	Colour to be used for grid lines.
alpha	A [0,1] number of colour transparency.
which	A vector of integers informing the units for which the aggregate transfer matrix should be plotted. Default, NULL: the global matrix is shown.
...	Other arguments passed on to methods. Not currently used.
show.plot	A TRUE/FALSE value indicating whether the plot should be displayed as a side-effect. By default, TRUE.

Value

Invisibly returns the (ggplot) description of the plot, which is a list with components that contain the plot itself, the data, information about the scales, panels etc.

Note

ggplot2 is needed to be installed for this function to work.

Author(s)

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Examples

```

votes1 <- structure(list(P1 = c(16L, 4L, 13L, 6L, 1L, 16L, 6L, 17L, 48L, 14L),
                        P2 = c(8L, 3L, 0L, 5L, 1L, 4L, 7L, 6L, 28L, 8L),
                        P3 = c(38L, 11L, 11L, 3L, 13L, 39L, 14L, 34L, 280L, 84L),
                        P4 = c(66L, 5L, 18L, 39L, 30L, 57L, 35L, 65L, 180L, 78L),
                        P5 = c(14L, 0L, 5L, 2L, 4L, 21L, 6L, 11L, 54L, 9L),
                        P6 = c(8L, 2L, 5L, 3L, 0L, 7L, 7L, 11L, 45L, 17L),
                        P7 = c(7L, 3L, 5L, 2L, 3L, 17L, 7L, 13L, 40L, 8L)),
                    row.names = c(NA, 10L), class = "data.frame")
votes2 <- structure(list(C1 = c(2L, 1L, 2L, 2L, 0L, 4L, 0L, 4L, 19L, 14L),
                        C2 = c(7L, 3L, 1L, 7L, 2L, 5L, 3L, 10L, 21L, 6L),
                        C3 = c(78L, 7L, 28L, 42L, 28L, 84L, 49L, 85L, 260L, 100L),
                        C4 = c(56L, 14L, 20L, 7L, 19L, 54L, 22L, 50L, 330L, 91L),
                        C5 = c(14L, 3L, 6L, 2L, 3L, 14L, 8L, 8L, 45L, 7L)),
                    row.names = c(NA, 10L), class = "data.frame")
example <- BPF(votes1, votes2)
p <- plot(example, show.plot = FALSE)
p

```

print.BPF

Print a summary of an output of the BPF function

Description

Print method for objects obtained with the BPF function.

Usage

```

## S3 method for class 'BPF'
print(x, ..., margins = TRUE, digits = 2)

```

Arguments

x	An object output of the BPF function.
...	Other arguments passed on to methods. Not currently used.
margins	A TRUE/FALSE argument informing if the margins of the transition matrix should be displayed. Default, TRUE.
digits	Integer indicating the number of decimal places to be shown. Default, 2.

Value

No return value, called for side effects.

Author(s)

Jose M. Pavia, <pavia@uv.es>

Examples

```

votes1 <- structure(list(P1 = c(16L, 4L, 13L, 6L, 1L, 16L, 6L, 17L, 48L, 14L),
                        P2 = c(8L, 3L, 0L, 5L, 1L, 4L, 7L, 6L, 28L, 8L),
                        P3 = c(38L, 11L, 11L, 3L, 13L, 39L, 14L, 34L, 280L, 84L),
                        P4 = c(66L, 5L, 18L, 39L, 30L, 57L, 35L, 65L, 180L, 78L),
                        P5 = c(14L, 0L, 5L, 2L, 4L, 21L, 6L, 11L, 54L, 9L),
                        P6 = c(8L, 2L, 5L, 3L, 0L, 7L, 7L, 11L, 45L, 17L),
                        P7 = c(7L, 3L, 5L, 2L, 3L, 17L, 7L, 13L, 40L, 8L)),
                    row.names = c(NA, 10L), class = "data.frame")
votes2 <- structure(list(C1 = c(2L, 1L, 2L, 2L, 0L, 4L, 0L, 4L, 19L, 14L),
                        C2 = c(7L, 3L, 1L, 7L, 2L, 5L, 3L, 10L, 21L, 6L),
                        C3 = c(78L, 7L, 28L, 42L, 28L, 84L, 49L, 85L, 260L, 100L),
                        C4 = c(56L, 14L, 20L, 7L, 19L, 54L, 22L, 50L, 330L, 91L),
                        C5 = c(14L, 3L, 6L, 2L, 3L, 14L, 8L, 8L, 45L, 7L)),
                    row.names = c(NA, 10L), class = "data.frame")
example <- BPF(votes1, votes2, local = "none")
print(example, digits = 1, margins = TRUE)

```

```
print.summary.BPF      Print a summary of a summary.BPF object
```

Description

Print method for summary.BPFC objects

Usage

```
## S3 method for class 'summary.BPF'
print(x, ..., margins = TRUE, digits = 2)
```

Arguments

x	An summary.BPF class object.
...	Other arguments passed on to methods. Not currently used.
margins	A TRUE/FALSE argument informing if the margins of the transition matrix should be displayed. Default, TRUE.
digits	Integer indicating the number of decimal places to be shown. Default, 2.

Value

No return value, called for side effects.

summary.BPF

*Summarize a BPF output object***Description**

Summary method for objects obtained with the BPF function

Usage

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

Arguments

`object` An object output of the **BPF** function.
`...` Other arguments passed on to methods. Not currently used.

Value

An object of class "summary.BPF". A list with four components:

`prop.matrix` A matrix of order RxC with the estimated underlying proportions/rates of the vote transitions from election 1 to election 2.
`counts.matrix` A matrix of order RxC with the estimated vote transfers from election 1 to election 2.
`row.margins` A vector of length R with the aggregate observed/adjusted distribution of proportions of votes in election 1.
`col.margins` A vector of length C with the aggregate observed/adjusted distribution of proportions of votes in election 2.

Author(s)

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Examples

```
votes1 <- structure(list(P1 = c(16L, 4L, 13L, 6L, 1L, 16L, 6L, 17L, 48L, 14L),
                        P2 = c(8L, 3L, 0L, 5L, 1L, 4L, 7L, 6L, 28L, 8L),
                        P3 = c(38L, 11L, 11L, 3L, 13L, 39L, 14L, 34L, 280L, 84L),
                        P4 = c(66L, 5L, 18L, 39L, 30L, 57L, 35L, 65L, 180L, 78L),
                        P5 = c(14L, 0L, 5L, 2L, 4L, 21L, 6L, 11L, 54L, 9L),
                        P6 = c(8L, 2L, 5L, 3L, 0L, 7L, 7L, 11L, 45L, 17L),
                        P7 = c(7L, 3L, 5L, 2L, 3L, 17L, 7L, 13L, 40L, 8L)),
                    row.names = c(NA, 10L), class = "data.frame")
votes2 <- structure(list(C1 = c(2L, 1L, 2L, 2L, 0L, 4L, 0L, 4L, 19L, 14L),
                        C2 = c(7L, 3L, 1L, 7L, 2L, 5L, 3L, 10L, 21L, 6L),
                        C3 = c(78L, 7L, 28L, 42L, 28L, 84L, 49L, 85L, 260L, 100L),
                        C4 = c(56L, 14L, 20L, 7L, 19L, 54L, 22L, 50L, 330L, 91L)),
```

```
          C5 = c(14L, 3L, 6L, 2L, 3L, 14L, 8L, 8L, 45L, 7L)),  
          row.names = c(NA, 10L), class = "data.frame")  
example <- BPF(votes1, votes2, local = "none")  
summary(example)
```

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