

Package ‘MCAvariants’

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Type Package

Title Multiple Correspondence Analysis Variants

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Description Provides two variants of multiple correspondence analysis (ca):
multiple ca and ordered multiple ca via orthogonal polynomials of Emerson.

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angle	<i>Angle</i>
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Description

The **R** internal function `angle` is used to draw ellipses around points in graphical displays.

Details

This function is used in two other functions that are `caellipse` and `nscaellipse`.

References

Macdonald PDM 2002 Drawing an ellipse in Splus or R.
 Available at www.math.mcmaster.ca/peter/s4m03/s4m03_0102/ellipse.html (accessed August 18, 2016).

ellipse	<i>Ellipse</i>
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Description

This function is called internally from the graphical functions `caellipse` and `nscaellipse`. It constructs the algebraic ellipses of confidence.

Arguments

<code>hlaxa</code>	The length of the horizontal ellipse semi-axis.
<code>hlaxb</code>	The length of the vertical ellipse semi-axis.
<code>xc</code>	The coordinate of the generic point on the horizontal axis.
<code>yc</code>	The coordinate of the generic point on the vertical axis.
<code>col</code>	The color of ellipses.

Note

This function is called from the secondary graphical function `caellipse` or `nscaellipse`, which is called from the main plot function `plot.CAvariants` and it can be executed for all variants of correspondence analysis.

Author(s)

Rosaria Lombardo and Eric J Beh

References

Beh EJ and Lombardo R 2014 Correspondence Analysis: Theory, Practice and New Strategies. John Wiley & Sons.
 Macdonald PDM 2002 Drawing an ellipse in Splus or R.
 Available at www.math.mcmaster.ca/peter/s4m03/s4m03_0102/ellipse.html (accessed August 18, 2016).

graph1	<i>Secondary graphical function</i>
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Description

This function produces a classical plot when the input parameter of the main code `MCAvariants` has been set as `plottype="classic"`. This function allows the analyst to plot category and individual points in graphical displays, using symbols and labels for each point. It is called internally from the main graphical function `plotmcaorporateris`.

Usage

```
graph1(f, prop = 1, cex = 1, cex.lab = 0.8, cols = c(2, 4),
      main = "Plot", mar = c(5, 4, 4, 2) + 0.1, a1, a2, inertiapc, Inames)
```

Arguments

f	The coordinates of the variable category or the coordinates of the individuals (objects)
prop	The scaling parameter for specifying the limits of the plotting area. By default, it is equal to 1.
cex	The parameter that specifies the size of character labels of points in graphical displays. By default, it is equal to 1.
cex.lab	The parameter for setting the size of character labels of axes in graphical displays.
cols	The parameter for setting the column size of data table
main	The title of the plot.
mar	The parameter for setting the size of plot area in graphical displays.
a1	The dimension reflected along the horizontal (polynomial or principal) axis in the graphical display.
a2	The dimension reflected along the vertical (polynomial or principal) axis in the graphical display.
inertiapc	The percentage of explained inertia.
Inames	The labels of the row variable.

Details

This graphical function is used internally by the main graphical function `plotmca`.

Author(s)

Rosaria Lombardo

References

Lombardo R and Meulman JJ (2010) *Journal of Classification*, 27, 191-210.
Beh EJ Lombardo R (2014) *Correspondence Analysis, Theory, Practice and New Strategies*. Wiley

insertval2

Secondary function to code data

Description

Secondary function to code data in complete disjunctive form

Usage

```
insertval2(x, nmod)
```

Arguments

x	Data matrix in reduced coding (primitive coding)
nmod	number of categories of each variable

Details

It helps to return a matrix from reduced coding in complete disjunctive coding

Author(s)

Rosaria Lombardo

References

Lombardo R and Meulman JJ (2010) *Journal of Classification*, 27, 191-210.
Beh EJ Lombardo R (2014) *Correspondence Analysis, Theory, Practice and New Strategies*. Wiley

mcabasic

Classical multiple correspondence analysis

Description

This function is used in the main function `MCAvariants` when the input parameter is `catype="mca"`.

Usage

```
mcabasic(xo, np = 2, nmod = c(5, 5), tmod = 10, rows = 511, idr, idc, idcv)
```

Arguments

<code>xo</code>	The starting table of variables in reduced code.
<code>np</code>	The column number of the starting table (coincident with the variable number).
<code>nmod</code>	The number of variable categories of each variable.
<code>tmod</code>	The total number of variable categories.
<code>rows</code>	The row number of the starting table (coincident with the individual number).
<code>idr</code>	The row labels of the data table.
<code>idc</code>	The column labels of the data table.
<code>idcv</code>	The labels of the categories of each variable.

Note

This function belongs to the R object class called `mcabasicresults`.

Author(s)

Rosaria Lombardo

References

Lombardo R and Meulman JJ (2010) *Journal of Classification*, 27, 191-210.
Beh EJ Lombardo R (2014) *Correspondence Analysis, Theory, Practice and New Strategies*. Wiley

mcbasicresults-class *Class* "mcbasicresultsclass"

Description

The Class of objects common to the two variants of multiple correspondence analysis

Objects from the Class

Objects can be created by calls of the form `mcbasicresultsclass(...)`.

Slots

RX: Object of type "matrix". The weighted super-indicator table.
CX: Object of type "matrix". The weighted transposed super-indicator table.
Rweights: Object of type "matrix". The weights of row space.
Cweights: Object of type "matrix". The weights of column space.
nmod: Object of type "vector". The number of categories of each variables.
tmod: Object of type "numeric". The total number of categories in the super-indicator table.
np: Object of type "numeric". The total number of variables.
Raxes: Object of type "matrix". The axes of row space.
Caxes: Object of type "matrix". The axes of column space.
mu: Object of type "numeric". The singular values when `catype="mca"` or eigenvalues when `catype="omca"`.
dj: Object of type "matrix". The supe-diagonal column weight matrix.
xo: Object of type "matrix". The original data table.
listBpoly: Object of type "list". The orthogonal polynomials related to each ordered variable when `catype="omca"`.
LinearPercentage: Object of type "vector". The percentage number of the individuals in clusters when `catype="omca"`.
BURT: Object of type "list". The contingency tables composing the Burt table.

Methods

No methods defined with class "mcbasicresultsclass" in the signature.

Author(s)

Rosaria Lombardo

References

Lombardo R and Meulman JJ (2010) *Journal of Classification*, 27, 191-210.
 Beh EJ Lombardo R (2014) *Correspondence Analysis, Theory, Practice and New Strategies*. Wiley

Examples

```
showClass("mcbasicresults")
```

mcaellipse

Algebraic elliptical confidence regions

Description

It produces elliptical confidence regions when multiple correspondence analysis is performed. This function allows the analyst to superimpose confidence ellipses into a graphical display when the input parameter `catype` of the main code `MCAvariants` is equal to "mca" or "omca". It is called internally from the main plot function `plot.MCAvariants`. It uses the function `ellipse`.

Usage

```
mcaellipse(Xtable, a1 = 1, a2 = 2, alpha = 0.05, cols = c(2, 4), np=5,
nmod=c(5,5,5,5,5), M = 2, cex = 0.8, cex.lab = 0.8,
mar = c(5, 4, 4, 2) + 0.1, prop = 0.8, Imass,
Jmass, a, b, g, fr, dm, inertiapc, pos = 2, graphy = TRUE, ell = FALSE)
```

Arguments

<code>Xtable</code>	The two-way contingency table.
<code>a1</code>	The dimension reflected along the horizontal axis.
<code>a2</code>	The dimension reflected along the vertical axis.
<code>alpha</code>	The confidence level of the elliptical regions. By default, <code>alpha = 0.05</code> .
<code>cols</code>	The graphical parameter for setting the colours of the points in the graphical displays.
<code>np</code>	The input parameter for specifying the number of categorical variables.
<code>nmod</code>	The input parameter (it is a vector) for specifying the number of categories of each categorical variables.
<code>M</code>	The number of axes used when drawing ellipse. By default, <code>M = 2</code> . Its maximum value is equal to the rank of the data matrix.
<code>cex</code>	The parameter for setting the size of character labels of points in graphical displays. By default, <code>cex = 0.8</code> .
<code>cex.lab</code>	The parameter for setting the size of character labels of axes in graphical displays. By default, <code>cex.lab = 0.8</code> .
<code>mar</code>	The parameter for setting the size of the plotting area.
<code>prop</code>	The scaling parameter for specifying the limits of the plotting area. By default, <code>prop = 1</code> .
<code>Imass</code>	The weight matrix of the row variable.
<code>Jmass</code>	The weight matrix of the column variable.

a	The row principal or polynomial axes.
b	The column principal or polynomial axes.
fr	The row coordinates.
g	The column coordinates.
dmu	The squared singular values or inertia of each axis.
inertiapc	The percentage of explained inertia.
pos	The parameter that specifies the position of point symbols in the graphical displays. By default, pos = 2.
graphy	The flag parameter used for displaying ellipses when using plot.CAvariants and not displaying when using print.CAvariants function. It is set as graphy = TRUE in plot.CAvariants and as graphy = FALSE in print.CAvariants.
e11	The flag parameter used for displaying ellipse. By default, e11 = TRUE.

Details

The output values of this function.

Value

eccentricity	Value of ellipse eccentricity. This is the distance between the ellipse center and either of its two foci, which can be thought of as a measure of how much the conic section deviates from being circular (when it is equal to zero then the region becomes circular).
HL Axis 1	Value of ellipse semi-axis 1 for each row and column points.
HL Axis 2	Value of ellipse semi-axis 2 for each row and column points.
Area	Ellipse area for each row and column points.
pvalcol	P-value for each row and column points.

Note

This function is called from the main plot function plot.MCAvariants and is executed when e11 = TRUE.

Author(s)

Rosaria Lombardo and Eric J Beh

References

Beh EJ and Lombardo R 2014 Correspondence Analysis: Theory, Practice and New Strategies. John Wiley & Sons.

mcafun	<i>Classical multiple correspondence analysis</i>
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Description

This function is used in the secondary function `mcabasic` when the input parameter of `MCAvariants` is `catype="mca"`. It performs the singular value decomposition of the weighted super-indicator matrix and compute principal axes, coordinates, weights of rows and columns and total inertia.

Usage

```
mcafun(X0, Burt, np, idr, idc, nmod)
```

Arguments

<code>X0</code>	The super-indicator data table.
<code>Burt</code>	The Burt data table.
<code>np</code>	The number of categorical variables.
<code>idr</code>	The row labels of data table.
<code>idc</code>	The column labels of data table.
<code>nmod</code>	The category number of each variable.

Author(s)

Rosaria Lombardo

References

Lombardo R and Meulman JJ (2010) *Journal of Classification*, 27, 191-210.
 Beh EJ Lombardo R (2014) *Correspondence Analysis, Theory, Practice and New Strategies*. Wiley

MCAvariants	<i>Classic and Ordered Multiple Correspondence Analysis</i>
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Description

It performs Classic Multiple Correspondence analysis for nominal variables (setting `catype="mca"`) and Ordered Multiple Correspondence analysis via orthogonal polynomials (setting `catype="omca"`). When the categorical variables are nominal and ordinal, you can specify writing `FALSE` or `TRUE` in the input parameter `vordered`.

Usage

```
MCAvariants(Xtable, catype = "mca", np = 5, vordered = c(TRUE,TRUE,TRUE,TRUE,TRUE))
```

Arguments

Xtable	The two-way contingency table.
catype	The input parameter for specifying what variant of multiple correspondence analysis is considered. By default, <code>catype = "mca"</code> .
np	The input parameter for specifying the number of categorical variables. By default, <code>np = 5</code> .
vordered	The flag parameter for specifying what variable is ordered, the ordered variables should be in column close each other. By default, all the five variables are ordered: <code>vordered = c(FALSE, FALSE, TRUE, TRUE, TRUE)</code> .

Value

Description of the output returned

Xtable	The starting table of variables in reduced (primitive) code.
rows	The row number of the starting table.
cols	The column number of the starting table (coincident with the variable number).
rowlabels	The label of the row individuals.
columnlabels	The label of the column variable categories.
Rprinccoord	The coordinates of individuals.
Cprinccoord	The category variable coordinates.
inertiaXsum	The total inertia when multiple correspondence analysis is performed on the indicator table.
inertiaBurtsun	The total inertia when multiple correspondence analysis is performed on the Burt table.
inertias	Benzecri's Adjusted Inertia values, percentages and cumulative values.
inertiasAdjusted	The adjusted inertia values.
catype	The kind of multiple correspondence analysis chosen, classical or ordered, that is <code>catype</code> is "mca" or "omca".
printdims	The dimension of a matrix in print. By default it is equal to 3.
comp	The polynomial components of inertia when <code>catype</code> is "omca". The total inertia is partitioned in terms of polynomial components.
componentpvalue1	The p-value of the polynomial components of total inertia, when <code>catype</code> is "omca".
degreef	The degree of freedom of polynomial components of total inertia when, <code>catype</code> is "omca".

Note

This function recalls internally two other functions, depending on the setting of the input parameter `catype`, it recalls multiple correspondence analysis or ordered multiple correspondence analysis. It gives the output object necessary for printing and plotting the results. These two important functions are `print.MCAvariants` and `plot.MCAvariants`.

Author(s)

Rosaria Lombardo and Eric J Beh

References

Lombardo R and Meulman JJ (2010) Journal of Classification, 27, 191-210.
Beh EJ Lombardo R (2014) Correspondence Analysis, Theory, Practice and New Strategies. Wiley

Examples

```
data(satisfaction)
MCAvariants(satisfaction, catype = "omca")
MCAvariants(satisfaction, catype = "mca")
```

miocount	<i>The counting function</i>
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Description

The function that counts the number of individuals in each clusters automatically generated in ordered multiple correspondence analysis.

Usage

```
miocount(x)
```

Arguments

x The coordinates of axes

Note

This function is used in the function `omcabasic` when in the main function `MCAvariants` the input parameter is `catype="omca"`.

Author(s)

Rosaria Lombardo

References

Lombardo R and Meulman JJ (2010) Journal of Classification, 27, 191-210.
Beh EJ Lombardo R (2014) Correspondence Analysis, Theory, Practice and New Strategies. Wiley

 omcabasic

Ordered multiple correspondence analysis via orthogonal polynomials

Description

This function is used in the main function `MCAvariants` when the input parameter is `catype="omca"`. It requires that all categorical variables are ordered variables. It performs the hybrid decomposition of the weighted super-indicator matrix and compute polynomial axes, coordinates, weights of rows and columns and total inertia.

Usage

```
omcabasic(xo, vordered= c(FALSE, FALSE, TRUE, TRUE, TRUE))
```

Arguments

<code>xo</code>	The starting table of variables in reduced code.
<code>vordered</code>	The flag parameter for specifying what variable is ordered. By default, all the five variables are ordered: <code>vordered = c(FALSE, FALSE, TRUE, TRUE, TRUE)</code> .

Note

This function belongs to the R object class called `mcabasicresults`.

Author(s)

Rosaria Lombardo

References

Lombardo R and Meulman JJ (2010) *Journal of Classification*, 27, 191-210.
 Beh EJ Lombardo R (2014) *Correspondence Analysis, Theory, Practice and New Strategies*. Wiley

 orthopoly

Orthogonal polynomials

Description

This function is called from the function `omca`. It allows the analyst to compute the orthogonal polynomials of each ordered categorical variable. The number of the polynomials is equal to the variable category less one. The function computes the polynomial transformation of the ordered categorical variable.

Usage

```
orthopoly(marginals, scores)
```

Arguments

scores The ordered scores of an ordered variable. By default mj=NULL, the natural scores (1,2,...) are computed.

marginals The marginals, relative frequencies of the ordered variable.

Value

Describe the value returned

B the matrix of the orthogonal polynomials without the trivial polynomial.

Note

Note that the sum of the marginals of the ordered variables should be one. At the end, the various polynomial matrices will be stored in a super-diagonal matrix.

Author(s)

Rosaria Lombardo and Eric J Beh

References

Beh EJ and Lombardo R 2014 Correspondence analysis, Theory, Practice and New Strategies. Wiley.

Examples

```
orthopoly(marginals=c(.1,.2,.3,.2,.2), scores=c(1,2,3,4,5))
```

plot.MCAvariants	<i>Main plot function for classical and ordered multiple correspondence analysis</i>
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Description

This function allows the analyst to produce the suitable graphical displays with respect to the classical and ordered multiple correspondence analysis. The main plot function called from the main function MCAvariants. It produces classical graphical displays for catype = "mca" and catype = "omca".

Usage

```
## S3 method for class 'MCAvariants'
plot(x, catype = "mca", firstaxis = 1, lastaxis = 2, cex = 0.8,
     cex.lab = 0.8, prop = 1, M=2, ell=FALSE,...)
```

Arguments

x	Represents the set of the output parameters of the main function MCAvariants of the R object class mcacorporateris.
catype	The input parameter specifying what variant of correspondence analysis is requested.
firstaxis	The dimension reflected along the horizontal axis.
lastaxis	The dimension reflected along the vertical axis.
cex	The parameter that specifies the size of character labels of points in graphical displays. By default, it is equal to 1.
cex.lab	The parameter cex.lab that specifies the size of character labels of axes in graphical displays. By default, cex.lab = 0.8.
prop	The scaling parameter for specifying the limits of the plotting area. By default, it is equal to 1.
M	The number of axes M considered when portraying the elliptical confidence regions. By default, it is equal to M = 2.
e11	The logical parameter, e11 which specifies whether algebraic confidence ellipses are to be included in the plot or not. Setting the input parameter to e11 = TRUE will allow the user to assess the statistical significance of each category to the association between the variables. The ellipses will be included when the plot is constructed using principal coordinates. By default, this input parameter is set to e11 = FALSE.
...	Further arguments passed to or from other methods.

Details

It produces classical graphical displays. Further when catype is equal to "omca", the individual clusters are portrayed.

Author(s)

Rosaria Lombardo and Eric J Beh

References

Lombardo R and Meulman JJ (2010) Journal of Classification, 27, 191-210.
Beh EJ Lombardo R (2014) Correspondence Analysis, Theory, Practice and New Strategies. Wiley

Examples

```
data(satisfaction)
ris1=MCAvariants(satisfaction, catype = "mca")
plot.MCAvariants(ris1)
print.MCAvariants(ris1)
ris2=MCAvariants(satisfaction, catype = "omca")
plot.MCAvariants(ris2)
print.MCAvariants(ris2)
```

print.MCAvariants *Main printing function*

Description

This function prints results of classical or ordered multiple correspondence analysis. The input parameter is the name of the output of the main function `MCAvariants`.

Usage

```
## S3 method for class 'MCAvariants'
print(x, printdims = 2,...)
```

Arguments

<code>x</code>	The output of the main function <code>CAvariants</code> .
<code>printdims</code>	The number of dimensions, <code>printdims</code> , that are used to generate the correspondence plot and for summarising the numerical output of the analysis. By default, <code>printdims = 2</code> .
<code>...</code>	Further arguments passed to or from other methods.

Details

This function uses another function (called `printwithaxes`) for specifying the number of matrix dimensions to print.

Value

The value of output returned depends on the kind of multiple correspondence analysis performed.

<code>DataTable</code>	The Burt data table.
<code>Row coordinates</code>	Rows in principal coordinates: the first 10.
<code>Column coordinates</code>	Column in principal coordinates.
<code>Polynomials</code>	Polynomial functions of each variable. When <code>catype</code> is <code>omca</code> .
<code>Linear Percentage of Clusters</code>	The percentage of individuals belonging to each cluster. When <code>catype</code> is <code>omca</code> .
<code>Polynomial Components of Total Inertia</code>	The decomposition of total inertia via orthogonal polynomials. When <code>catype</code> is <code>omca</code> .
<code>Degree of Freedom</code>	Degree of Freedom of Polynomial Component. When <code>catype</code> is <code>omca</code> .
<code>Inertia values</code>	Inertia values of super-indicator and Burt table.
<code>Benzecri's Inertia values</code>	Adjusted Inertia values, percentages and cumulative.

Total Degree of Freedom
 The degree of freedom of total inertia.
 Total inertia of X
 Total inertia of Super-Indicator table
 Total inertia of B
 Total inertia of BURT table.
 Chi-square values
 Chi-square values of BURT Inertia.
 Total Chi-square values
 Chi-square values of total Inertia of Burt table.

Author(s)

Rosaria Lombardo

References

Lombardo R and Meulman JJ (2010) *Journal of Classification*, 27, 191-210.
 Beh EJ Lombardo R (2014) *Correspondence Analysis, Theory, Practice and New Strategies*. Wiley

printwithaxes *Secondary printing function*

Description

The function is called from the main print function `printmcorporateris`. It adds the names to objects.

Usage

```
printwithaxes(res, thenames)
```

Arguments

`res` An R object.
`thenames` A character vector of up to the same length as `x`.

Note

It is called from `printmcorporateris`.

Author(s)

Rosaria Lombardo

References

Lombardo R and Meulman JJ (2010) *Journal of Classification*, 27, 191-210.
 Beh EJ Lombardo R (2014) *Correspondence Analysis, Theory, Practice and New Strategies*. Wiley

satisfaction

Patient Satisfaction

Description

The data set consists of 235 rows and 5 columns. The rows represent the individuals (patients in an hospital) and the columns concern the five variables of satisfaction (Tangibility, Reliability, Capacity of Response, Capacity of Assurance and Empathy)

Usage

```
data(satisfaction)
```

Format

A data frame with 235 observations on the following 5 variables.

TANG a numeric vector of ordered categories ranging from 1 to 5.

REL a numeric vector of ordered categories ranging from 1 to 5.

CRES a numeric vector of ordered categories ranging from 1 to 5.

CASS a numeric vector of ordered categories ranging from 1 to 5.

EMPAT a numeric vector of ordered categories ranging from 1 to 5.

Source

Della Valle E (2010) Della Valle E 2010 Analisi Multidimensionale dei Dati: la Qualit\`a del Lavoro nelle Cooperative Sociali. Unpublished thesis, Seconda Universit\`a degli Studi di Napoli, Capua Italy.

Examples

```
data(satisfaction)
dim(satisfaction)
dimnames(satisfaction)
```

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