

# 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.

**Depends** R (> 3.0.1), methods, tools

**Imports** ggplot2, ggrepel, gridExtra, plotly

**LazyData** true

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## R topics documented:

alligator.dat . . . . .	2
caplot3d . . . . .	3
insertval2 . . . . .	4
mcabasic . . . . .	4
mcafun . . . . .	5
MCAvariants . . . . .	6
miocount . . . . .	7
omcabasic . . . . .	8
orthopoly . . . . .	9
plot.MCAvariants . . . . .	10
print.MCAvariants . . . . .	11
printwithaxes . . . . .	13

satisfaction . . . . .	14
tableconvert . . . . .	14

<b>Index</b>	<b>16</b>
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alligator.dat	<i>Alligator in American lakes</i>
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### Description

The data set is a three-way contingency table. It consists of 2 rows (alligators' size), 5 columns (alligators' food) by 4 tubes (alligators' lake). The table should be converted in reduced code table, using the function `tableconvert` for getting `alligatormca`.

### Usage

```
data(alligator.dat)
```

### Format

A data frame with 300 alligators on the following 3 variables.

**Size** A numeric vector of categories ranging from 1 to 2 (small and large).

**Food** A numeric vector of categories ranging from 1 to 5 (type of food: fish, invertebrate, reptile, bird, other).

**Lake** a numeric vector of categories ranging from 1 to 4 for the four American lakes: Hancock, Oklawaha, Trafford, George.

### Source

Agresti (2007), p. 270

Agresti A and Gottard A 2007 Independence in multiway contingency tables: S.n. roys break-throughs and later developments. *Journal of Statistical Planning and Inference*, 137:3126–3226.

### Examples

```
data(alligator.dat)
#dim(alligator.dat)
#dimnames(alligator.dat)
```

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caplot3d	<i>Three dimensional correspondence plot</i>
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**Description**

This function is used in the plot function plot.CAvariants when the logical parameter is plot3d = TRUE. It produces a 3-dimensional visualization of the association.

**Usage**

```
caplot3d(coordR, coordC, inertiaPer, firstaxis = 1, lastaxis = 2, thirddaxis = 3)
```

**Arguments**

coordR	The row principal or standard coordinates.
coordC	The column principal or standard coordinates.
inertiaPer	The percentage of the total inertia explained inertia by each dimension.
firstaxis	The first axis number. By default, firstaxis = 1.
lastaxis	The second axis number. By default, lastaxis = 2.
thirddaxis	The third axis number. By default, thirddaxis = 3.

**Note**

This function depends on the R library plotly.

**Author(s)**

Rosaria Lombardo and Eric J. Beh

**References**

Beh EJ and Lombardo R 2014 Correspondence Analysis: Theory, Practice and New Strategies. Wiley.  
Lombardo R Beh EJ 2016 Variants of Simple Correspondence Analysis. The R Journal, 8 (2), 167–184.

insertval2                      *Secondary function to code data*

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**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

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mcbasic                      *Classical multiple correspondence analysis*

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**Description**

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

**Usage**

```
mcbasic(xo, np, nmod, tmod, rows, idr, idc, idcv)
```

**Arguments**

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

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 mcafun

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*Classical multiple correspondence analysis*


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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**

X0	The super-indicator data table.
Burt	The Burt data table.
np	The number of categorical variables.
idr	The row labels of data table.
idc	The column labels of data table.
nmod	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

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 MCAvariants

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*Classic and Ordered Multiple Correspondence Analysis*


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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 = "omca", np = 5, vordered=c(TRUE, TRUE, TRUE, TRUE, TRUE))
```

**Arguments**

<code>Xtable</code>	The two-way contingency table.
<code>catype</code>	The input parameter for specifying what variant of multiple correspondence analysis is considered. By default, <code>catype = "mca"</code> .
<code>np</code>	The input parameter for specifying the number of categorical variables. By default, <code>np = 5</code> .
<code>vordered</code>	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(TRUE, TRUE, TRUE, TRUE, TRUE)</code> .

**Value**

Description of the output returned

<code>Xtable</code>	The starting table of variables in reduced (primitive) code.
<code>rows</code>	The row number of the starting table.
<code>cols</code>	The column number of the starting table (coincident with the variable number).
<code>rowlabels</code>	The label of the row individuals.
<code>columnlabels</code>	The label of the column variable categories.
<code>Rprinccoord</code>	The coordinates of individuals.
<code>Cprinccoord</code>	The category variable coordinates.

inertiaXsum	The total inertia when multiple correspondence analysis is performed on the indicator table.
inertiaBurtsum	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 catype 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 catype is "omca". The total inertia is partitioned in terms of polynomial components.
componentpvalue1	The p-value of the polynomial components of total inertia, when catype is "omca".
degreef	The degree of freedom of polynomial components of total inertia when, catype 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

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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 correpondence 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

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omcabasic	<i>Ordered multiple correspondence analysis via orthogonal polynomials</i>
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**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,np , nmod , tmod , rows, idr, idc, idcv,vordered)
```

**Arguments**

xo                    The starting table of variables in reduced code.  
np                    The column number of the starting table (coincident with the variable number). By default,np=5.  
nmod                  The number of variable categories of each variable.  
tmod                  The total number of variable categories.  
rows                  The row number of the starting table (coincident with the individual number).  
idr                    The row labels of the data table.  
idc                    The column labels of the data table.  
idcv                  The labels of the categories of each variable.  
vordered              The flag parameter for specifying what variable is ordered. By default, all the five variables are ordered: `vordered = c(TRUE, TRUE, TRUE, TRUE, TRUE)`.



**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

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orthopoly	<i>Orthogonal polynomials</i>
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**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 <code>mj=NULL</code> , 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.
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**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))
```

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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, thirdaxis = 3, cex = 0.8,
     cex.lab = 0.8, prop = 1, plot3d = FALSE, plotind= FALSE, M=2,...)
```

## Arguments

<code>x</code>	Represents the set of the output parameters of the main function MCAvariants of the R object class <code>mcacorporateris</code> .
<code>catype</code>	The input parameter specifying what variant of correspondence analysis is requested.
<code>firstaxis</code>	The dimension reflected along the horizontal axis.
<code>lastaxis</code>	The dimension reflected along the vertical axis.
<code>thirdaxis</code>	The third axis number when <code>plot3d = TRUE</code> . By default, <code>thirdaxis = 3</code> .
<code>cex</code>	The parameter that specifies the size of character labels of points in graphical displays. By default, it is equal to 1.
<code>cex.lab</code>	The parameter <code>cex.lab</code> that specifies the size of character labels of axes in graphical displays. By default, <code>cex.lab = 0.8</code> .
<code>prop</code>	The scaling parameter for specifying the limits of the plotting area. By default, it is equal to 1.
<code>plot3d</code>	The logical parameter specifies whether a 3D plot is to be included in the output or not. By default, <code>plot3d = FALSE</code> .

plotind	The logical parameter specifies whether a plot of individuals is to be included in the output or not. By default, plotind = FALSE.
M	The number of axes M considered when portraying the elliptical confidence regions. By default, it is equal to M = 2.
...	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)
res1=MCAvariants(satisfaction, catype = "mca", np=5)
plot(res1)
res2=MCAvariants(satisfaction, catype = "omca", np = 5, vordered=c(TRUE,TRUE,TRUE,TRUE,TRUE))
plot(res2)
```

---

print.MCAvariants      *Main printing function*

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### 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

x	The output of the main function CAvariants.
printdims	The number of dimensions, printdims, that are used to generate the correspondence plot and for summarising the numerical output of the analysis. By default, printdims = 2.
...	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.

`DataTable`      The Burt data table.

Row coordinates

Rows in principal coordinates: the first 10.

Column coordinates

Column in principal coordinates.

Polynomials      Polynomial functions of each variable. When `catype` is `omca`.

Linear Percentage of Clusters

The percentage of individuals belonging to each cluster. When `catype` is `omca`.

Polynomial Components of Total Inertia

The decomposition of total inertia via orthogonal polynomials. When `catype` is `omca`.

Degree of Freedom

Degree of Freedom of Polynomial Component. When `catype` is `omca`.

Inertia values    Inertia values of super-indicator and Burt table.

Benzecri's Inertia values

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

**Examples**

```
res=MCAvariants(satisfaction, catype = "omca", np = 5, vordered=c(TRUE,TRUE,TRUE,TRUE,TRUE))
print(res)
```

---

printwithaxes	<i>Secondary printing function</i>
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**Description**

The function is called from the main print function printmccorporateris. 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 printmccorporateris.

**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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tableconvert                      *Convert contingency table in table of reduced code*

---

**Description**

This simple piece of R code converts a two-way or three-way contingency table into what is required to analyse MCA (table of reduced code: n by number of variables).

**Usage**

```
tableconvert(N)
```

**Arguments**

N                    A two-way or three-way contingency table to convert in a table n by np, where np is the number of the categorical variables.

**Author(s)**

Rosaria Lombardo and Eric J Beh

**References**

Beh EJ Lombardo R (2014) Correspondence Analysis, Theory, Practice and New Strategies. Wiley

**Examples**

```
alligatormca<-tableconvert(alligator.dat)
dimnames(alligatormca)<-list(paste("a", 1:300, sep = ""),c("Size", "Food", "Lake"))
```

# Index

- \* **datasets**
  - alligator.dat, 2
  - satisfaction, 14
- \* **graphical**
  - plot.MCAvariants, 10
- \* **multivariate**
  - insertval2, 4
  - mcabasic, 4
  - mcafun, 5
  - MCAvariants, 6
  - miocount, 7
  - omcabasic, 8
  - print.MCAvariants, 11
  - printwithaxes, 13
  - tableconvert, 14
- \* **nonparametric**
  - orthopoly, 9
- \* **plot**
  - caplot3d, 3

alligator.dat, 2

caplot3d, 3

insertval2, 4

mcabasic, 4

mcafun, 5

MCAvariants, 6

miocount, 7

omcabasic, 8

orthopoly, 9

plot.MCAvariants, 10

print.MCAvariants, 11

printwithaxes, 13

satisfaction, 14

tableconvert, 14