

# Package ‘ExPosition’

October 12, 2022

**Type** Package

**Title** Exploratory Analysis with the Singular Value Decomposition

**Version** 2.8.23

**Date** 2018-12-27

**Author** Derek Beaton, Cherise R. Chin Fatt, Herve Abdi

**Maintainer** Derek Beaton <exposition.software@gmail.com>

**Description** A variety of descriptive multivariate analyses with the singular value decomposition, such as principal components analysis, correspondence analysis, and multidimensional scaling. See An ExPosition of the Singular Value Decomposition in R (Beaton et al 2014) <doi:10.1016/j.csda.2013.11.006>.

**License** GPL-2

**Depends** prettyGraphs (>= 2.1.4)

**BugReports** [https://github.com/derekbeaton/ExPosition-Family\\_OLD](https://github.com/derekbeaton/ExPosition-Family_OLD)

**NeedsCompilation** no

**Repository** CRAN

**Date/Publication** 2019-01-07 17:00:41 UTC

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ExPosition-package      *ExPosition: Exploratory Analysis with the Singular Value Decomposition*

---

## Description

Exposition is defined as *a comprehensive explanation of an idea*. With ExPosition for R, a comprehensive explanation of your data will be provided with minimal effort.

The core of ExPosition is the singular value decomposition (SVD; see: [svd](#)). The point of ExPosition is simple: to provide the user with an overview of their data that only the SVD can provide. ExPosition includes several techniques that depend on the SVD (see below for examples and functions).

## Details

Package:    ExPosition  
Type:        Package  
Version:    2.8.23  
Date:        2018-12-27  
Depends:   R (>=2.15.0), prettyGraphs (>= 2.1.4)  
License:    GPL-2  
URL:        [https://github.com/derekbeaton/ExPosition-Family\\_OLD](https://github.com/derekbeaton/ExPosition-Family_OLD)

## Author(s)

Questions, comments, compliments, and complaints go to Derek Beaton <[exposition.software@gmail.com](mailto:exposition.software@gmail.com)>.

The following people are authors or contributors to ExPosition code, data, or examples:  
Derek Beaton, Hervé Abdi, Cherise Chin-Fatt, Joseph Dunlop, Jenny Rieck, Rachel Williams, Anjali Krishnan, and Francesca M. Filbey.

## References

- Abdi, H., and Williams, L.J. (2010). Principal component analysis. *Wiley Interdisciplinary Reviews: Computational Statistics*, 2, 433-459.
- Abdi, H. and Williams, L.J. (2010). Correspondence analysis. In N.J. Salkind, D.M., Dougherty, & B. Frey (Eds.): *Encyclopedia of Research Design*. Thousand Oaks (CA): Sage. pp. 267-278.
- Abdi, H. (2007). Singular Value Decomposition (SVD) and Generalized Singular Value Decomposition (GSVD). In N.J. Salkind (Ed.): *Encyclopedia of Measurement and Statistics*. Thousand Oaks (CA): Sage. pp. 907-912.
- Abdi, H. (2007). Metric multidimensional scaling. In N.J. Salkind (Ed.): *Encyclopedia of Measurement and Statistics*. Thousand Oaks (CA): Sage. pp. 598-605.
- Greenacre, M. J. (2007). Correspondence Analysis in Practice. *Chapman and Hall*.
- Benzécri, J. P. (1979). Sur le calcul des taux d'inertie dans l'analyse d'un questionnaire. *Cahiers de l'Analyse des Données*, 4, 377-378.

## See Also

[epPCA](#), [epGPCA](#), [epMDS](#), [epCA](#), [epMCA](#)

## Examples

#For more examples, see each individual function (as noted above).

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acknowledgements	<i>acknowledgements</i>
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## Description

acknowledgements returns a list of people who have contributed to ExPosition.

## Usage

```
acknowledgements()
```

## Value

A list of people who have contributed something beyond code to the ExPosition family of packages.

## Author(s)

Derek Beaton

---

authors *(A truncated form of) Punctuation used by six authors (data).*

---

### Description

How six authors use 3 different types of punctuation throughout their writing.

### Usage

data(authors)

### Format

authors\$ca\$data: Six authors (rows) and the frequency of three punctuations (columns). For use with [epCA](#).

authors\$mca\$data: A Burt table reformatting of the \$ca\$data. For use with [epMCA](#).

### References

Brunet, E. (1989). Faut-il ponderer les donnees linguistiques. *CUMFID*, 16, 39-50.

Abdi, H., and Williams, L.J. (2010). Principal component analysis. *Wiley Interdisciplinary Reviews: Computational Statistics*, 2, 433-459.

Abdi, H., and Williams, L.J. (2010). Correspondence analysis. In N.J. Salkind, D.M., Dougherty, & B. Frey (Eds.): *Encyclopedia of Research Design*. Thousand Oaks (CA): Sage. pp. 267-278.

---

bada.wine *Twelve wines from 3 regions in France with 18 attributes.*

---

### Description

This data should be used for discriminant analyses or analyses where the *group* information is important.

### Usage

data(bada.wine)

### Format

bada.wine\$data: Data matrix with twelve wines (rows) from 3 regions with 18 attributes (columns).

bada.wine\$design: Design matrix with twelve wines (rows) with 3 regions (columns) to indicate group relationship of the data matrix.

### References

Abdi, H. and Williams, L.J. (2010). Barycentric discriminant analysis (BADIA). In N.J. Salkind, D.M., Dougherty, & B. Frey (Eds.): *Encyclopedia of Research Design*. Thousand Oaks (CA): Sage. pp. 64-75.

beer.tasting.notes      *Some of authors' personal beer tasting notes.*

---

**Description**

Tasting notes, preferences, breweries and styles of 38 different craft beers from various breweries, across various styles.

**Usage**

```
data(beer.tasting.notes)
```

**Format**

beer.tasting.notes\$data: Data matrix. Tasting notes (ratings) of 38 different beers (rows) described by 16 different flavor profiles (columns).

beer.tasting.notes\$brewery.design: Design matrix. Source brewery of 38 different beers (rows) across 26 breweries (columns).

beer.tasting.notes\$style.design: Design matrix. Style of 38 different beers (rows) across 20 styles (columns) (styles as listed from Beer Advocate website).

beer.tasting.notes\$sup.data: Supplementary data matrix. ABV and overall preference ratings of 38 beers described by two features (ABV & overall) in original value and rounded value.

**Source**

Jenny Rieck and Derek Beaton laboriously “collected” these data for “experimental purposes”.

**References**

<http://www.beeradvocate.com>

---

beers2007      *Ten assessors sort eight beers into groups.*

---

**Description**

Ten assessors perform a free-sorting task to sort eight beers into groups.

**Usage**

```
data(beers2007)
```

**Format**

beers2007\$data: A data matrix with 8 rows (beers) described by 10 assessors (columns).

**References**

Abdi, H., Valentin, D., Chollet, S., & Chrea, C. (2007). Analyzing assessors and products in sorting tasks: DISTATIS, theory and applications. *Food Quality and Preference*, 627-640.

---

calculateConstraints    *calculateConstraints*

---

**Description**

Calculates constraints for plotting data..

**Usage**

```
calculateConstraints(results,x_axis=1,y_axis=2,constraints=NULL)
```

**Arguments**

results	results from ExPosition (i.e., \$ExPosition.Data)
x_axis	which component should be on the x axis?
y_axis	which component should be on the y axis?
constraints	if available, axis constraints for the plots (determines end points of the plots).

**Value**

Returns a list with the following items:

\$constraints	axis constraints for the plots (determines end points of the plots).
---------------	--

**Author(s)**

Derek Beaton

---

caNorm                                    *Correspondence analysis preprocessing*

---

**Description**

Performs all steps required for CA processing (row profile approach).

**Usage**

```
caNorm(X, X_dimensions, colTotal, rowTotal, grandTotal, weights = NULL, masses = NULL)
```

**Arguments**

<code>X</code>	Data matrix
<code>X_dimensions</code>	The dimensions of <code>X</code> in a vector of length 2 (rows, columns). See <code>dim</code>
<code>colTotal</code>	Vector of column sums.
<code>rowTotal</code>	Vector of row sums.
<code>grandTotal</code>	Grand total of <code>X</code>
<code>weights</code>	Optional weights to include for the columns.
<code>masses</code>	Optional masses to include for the rows.

**Value**

<code>rowCenter</code>	The barycenter of <code>X</code> .
<code>masses</code>	Masses to be used for the GSVD.
<code>weights</code>	Weights to be used for the GSVD.
<code>rowProfiles</code>	The row profiles of <code>X</code> .
<code>deviations</code>	Deviations of row profiles from <code>rowCenter</code> .

**Author(s)**

Derek Beaton

---

caSupplementalElementsPreProcessing

*Correspondence Analysis preprocessing.*

---

**Description**

CA preprocessing for data. Can be performed on rows or columns of your data. This is a row-profile normalization.

**Usage**

```
caSupplementalElementsPreProcessing(SUP.DATA)
```

**Arguments**

<code>SUP.DATA</code>	Data that will be supplemental. Row profile normalization is used. For supplemental rows use <code>t(SUP.DATA)</code> .
-----------------------	---

**Value**

returns a matrix that is preprocessed for supplemental projections.



**Author(s)**

Derek Beaton

**See Also**

[mdsSupplementalElementsPreProcessing](#), [pcaSupplementaryColsPreProcessing](#), [pcaSupplementaryRowsPreProcessing](#), [hellingerSupplementaryColsPreProcessing](#), [hellingerSupplementaryRowsPreProcessing](#), [supplementaryCols](#), [supplementaryRows](#), [supplementalProjection](#), [rowNorms](#)

---

 chi2Dist

*Chi-square Distance computation*


---

**Description**

Performs a chi-square distance. Primarily used for [epMDS](#).

**Usage**

```
chi2Dist(X)
```

**Arguments**

X                      Compute chi-square distances between row items.

**Value**

D                      Distance matrix for [epMDS](#) analysis.  
 MW                     a list of masses and weights. Weights not used in MDS.

**Author(s)**

Hervé Abdi

---

 coffee.data

*Small data set on flavor perception and preferences for coffee.*


---

**Description**

One coffee from Oak Cliff roasters (Dallas, TX) was used in this experiment. Honduran source with a medium roast. The coffee was brewed in two ways and served in two ways (i.e., a 2x2 design). Two batches each of coffee were brewed at 180 degrees (Hot) Farenheit or at room temperature (Cold). One of each was served cold or heated back up to 180 degrees (Hot).

**Usage**

```
data(coffee.data)
```

**Format**

coffee.data\$preferences: Ten participants indicated if they liked a particular serving or not.  
 coffee.data\$ratings: Ten participants indicated on a scale of 0-2 the presence of particular flavors.  
 In an array format.

**Details**

Flavor profiles measured: Salty, Spice Cabinet, Sweet, Bittery, and Nutty.

---

 computeMW

*computeMW*


---

**Description**

Computes masses and weights for [epGPCA](#).

**Usage**

```
computeMW(DATA, masses = NULL, weights = NULL)
```

**Arguments**

DATA	original data; will be used to compute masses and weights if none are provided.
masses	a vector or (diagonal) matrix of masses for the row items. If NULL (default), masses are computed as 1/# of rows
weights	a vector or (diagonal) matrix of weights for the column items. If NULL (default), weights are computed as 1/# of columns

**Value**

Returns a list with the following items:

M	a diagonal matrix of masses (if too large, a vector is returned).
W	a diagonal matrix of weights (if too large, a vector is returned).

**Author(s)**

Derek Beaton

**See Also**

[epGPCA](#)

---

coreCA	<i>coreCA</i>
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---

### Description

coreCA performs the core of correspondence analysis (CA), multiple correspondence analysis (MCA) and related techniques.

### Usage

```
coreCA(DATA, masses = NULL, weights = NULL, hellinger = FALSE, symmetric = TRUE,
decomp.approach = 'svd', k = 0)
```

### Arguments

DATA	original data to decompose and analyze via the singular value decomposition.
masses	a vector or diagonal matrix with masses for the rows (observations). If NULL, one is created or the plain SVD is used.
weights	a vector or diagonal matrix with weights for the columns (measures). If NULL, one is created or the plain SVD is used.
hellinger	a boolean. If FALSE (default), Chi-square distance will be used. If TRUE, Hellinger distance will be used.
symmetric	a boolean. If TRUE (default) symmetric factor scores for rows and columns are computed. If FALSE, the simplex (column-based) will be returned.
decomp.approach	string. A switch for different decompositions (typically for speed). See <a href="#">pickSVD</a> .
k	number of components to return (this is not a rotation, just an <i>a priori</i> selection of how much data should be returned).

### Details

This function should not be used directly. Please use [epCA](#) or [epMCA](#) unless you plan on writing extensions to ExPosition. Any extensions wherein CA is the primary analysis should use coreCA.

### Value

Returns a large list of items which are also returned in [epCA](#) and [epMCA](#) (the help files for those functions will refer to this as well).

All items with a letter followed by an *i* are for the *I* rows of a DATA matrix. All items with a letter followed by an *j* are for the *J* rows of a DATA matrix.

f <i>i</i>	factor scores for the row items.
d <i>i</i>	square distances of the row items.

ci	contributions (to the variance) of the row items.
ri	cosines of the row items.
fj	factor scores for the column items.
dj	square distances of the column items.
cj	contributions (to the variance) of the column items.
rj	cosines of the column items.
t	the percent of explained variance per component (tau).
eigs	the eigenvalues from the decomposition.
pdq	the set of left singular vectors (pdq\$p) for the rows, singular values (pdq\$Dv and pdq\$Dd), and the set of right singular vectors (pdq\$q) for the columns.
M	a column-vector or diagonal matrix of masses (for the rows)
W	a column-vector or diagonal matrix of weights (for the columns)
c	a centering vector (for the columns).
X	the final matrix that was decomposed (includes scaling, centering, masses, etc...).
hellinger	a boolean. TRUE if Hellinger distance was used.
symmetric	a boolean. FALSE if asymmetric factor scores should be computed.

### Author(s)

Derek Beaton and Hervé Abdi.

### References

- Abdi, H., and Williams, L.J. (2010). Principal component analysis. *Wiley Interdisciplinary Reviews: Computational Statistics*, 2, 433-459.
- Abdi, H., and Williams, L.J. (2010). Correspondence analysis. In N.J. Salkind, D.M., Dougherty, & B. Frey (Eds.): *Encyclopedia of Research Design*. Thousand Oaks (CA): Sage. pp. 267-278.
- Abdi, H. (2007). Singular Value Decomposition (SVD) and Generalized Singular Value Decomposition (GSVD). In N.J. Salkind (Ed.): *Encyclopedia of Measurement and Statistics*. Thousand Oaks (CA): Sage. pp. 907-912.
- Greenacre, M. J. (2007). Correspondence Analysis in Practice. *Chapman and Hall*.

### See Also

[epCA](#), [epMCA](#)

---

 coreMDS

*coreMDS*


---

**Description**

coreMDS performs metric multidimensional scaling (MDS).

**Usage**

```
coreMDS(DATA, masses = NULL, decomp.approach = 'svd', k = 0)
```

**Arguments**

DATA	original data to decompose and analyze via the singular value decomposition.
masses	a vector or diagonal matrix with masses for the rows (observations). If NULL, one is created.
decomp.approach	string. A switch for different decompositions (typically for speed). See <a href="#">pickSVD</a> .
k	number of components to return (this is not a rotation, just an <i>a priori</i> selection of how much data should be returned).

**Details**

[epMDS](#) should not be used directly unless you plan on writing extensions to `ExPosition`. See [epMDS](#)

**Value**

Returns a large list of items which are also returned in [epMDS](#).

All items with a letter followed by an *i* are for the *I* rows of a DATA matrix. All items with a letter followed by an *j* are for the *J* rows of a DATA matrix.

f <i>i</i>	factor scores for the row items.
d <i>i</i>	square distances of the row items.
c <i>i</i>	contributions (to the variance) of the row items.
r <i>i</i>	cosines of the row items.
masses	a column-vector or diagonal matrix of masses (for the rows)
t	the percent of explained variance per component (tau).
eigs	the eigenvalues from the decomposition.
pdq	the set of left singular vectors (pdq\$p) for the rows, singular values (pdq\$Dv and pdq\$Dd), and the set of right singular vectors (pdq\$q) for the columns.
X	the final matrix that was decomposed (includes scaling, centering, masses, etc...).

**Author(s)**

Derek Beaton and Hervé Abdi.

**References**

- Abdi, H. (2007). Metric multidimensional scaling. In N.J. Salkind (Ed.): *Encyclopedia of Measurement and Statistics*. Thousand Oaks (CA): Sage. pp. 598-605.
- O'Toole, A. J., Jiang, F., Abdi, H., and Haxby, J. V. (2005). Partially distributed representations of objects and faces in ventral temporal cortex. *Journal of Cognitive Neuroscience*, 17(4), 580-590.

**See Also**

[epMDS](#)

---

corePCA

*corePCA*

---

**Description**

corePCA performs the core of principal components analysis (PCA), generalized PCA (GPCA), multidimensional scaling (MDS), and related techniques.

**Usage**

```
corePCA(DATA, M = NULL, W = NULL, decomp.approach = 'svd', k = 0)
```

**Arguments**

DATA	original data to decompose and analyze via the singular value decomposition.
M	a vector or diagonal matrix with masses for the rows (observations). If NULL, one is created or the plain SVD is used.
W	a vector or diagonal matrix with weights for the columns (measures). If NULL, one is created or the plain SVD is used.
decomp.approach	string. A switch for different decompositions (typically for speed). See <a href="#">pickSVD</a> .
k	number of components to return (this is not a rotation, just an <i>a priori</i> selection of how much data should be returned).

**Details**

This function should not be used directly. Please use [epPCA](#) or [epGPCA](#) unless you plan on writing extensions to ExPosition.

**Value**

Returns a large list of items which are also returned in [epPCA](#) and [epGPCA](#) (the help files for those functions will refer to this as well).

All items with a letter followed by an *i* are for the *I* rows of a DATA matrix. All items with a letter followed by an *j* are for the *J* rows of a DATA matrix.

f <i>i</i>	factor scores for the row items.
d <i>i</i>	square distances of the row items.
c <i>i</i>	contributions (to the variance) of the row items.
r <i>i</i>	cosines of the row items.
f <i>j</i>	factor scores for the column items.
d <i>j</i>	square distances of the column items.
c <i>j</i>	contributions (to the variance) of the column items.
r <i>j</i>	cosines of the column items.
t	the percent of explained variance per component (tau).
eigs	the eigenvalues from the decomposition.
pdq	the set of left singular vectors (pdq\$p) for the rows, singular values (pdq\$Dv and pdq\$Dd), and the set of right singular vectors (pdq\$q) for the columns.
X	the final matrix that was decomposed (includes scaling, centering, masses, etc...).

**Author(s)**

Derek Beaton and Hervé Abdi.

**References**

Abdi, H., and Williams, L.J. (2010). Principal component analysis. *Wiley Interdisciplinary Reviews: Computational Statistics*, 2, 433-459.

Abdi, H. (2007). Singular Value Decomposition (SVD) and Generalized Singular Value Decomposition (GSVD). In N.J. Salkind (Ed.): *Encyclopedia of Measurement and Statistics*. Thousand Oaks (CA): Sage. pp. 907-912.

**See Also**

[epPCA](#), [epGPCA](#)

createDefaultDesign    *createDefaultDesign*

---

**Description**

Creates a default design matrix, wherein all observations (i.e., row items) are in the same group.

**Usage**

```
createDefaultDesign(DATA)
```

**Arguments**

DATA                    original data that requires a design matrix

**Value**

DESIGN                  a column-vector matrix to indicate that all observations are in the same group.

**Author(s)**

Derek Beaton

---

designCheck              *designCheck*

---

**Description**

Checks and/or creates a dummy-coded design matrix.

**Usage**

```
designCheck(DATA, DESIGN = NULL, make_design_nominal = TRUE)
```

**Arguments**

DATA                    original data that should be matched to a design matrix  
DESIGN                  a column vector with levels for observations or a dummy-coded matrix  
make\_design\_nominal    a boolean. Will make DESIGN nominal if TRUE (default).

**Details**

Returns a properly formatted, dummy-coded (or disjunctive coding) design matrix.



**Value**

DESIGN            dummy-coded design matrix

**Author(s)**

Derek Beaton

**Examples**

```
data <- iris[,c(1:4)]
design <- as.matrix(iris[,c('Species')])
iris.design <- designCheck(data,DESIGN=design,make_design_nominal=TRUE)
```

---

dica.ad

*Alzheimer's Patient-Spouse Dyads.*

---

**Description**

Conversational data from Alzheimer's Patient-Spouse Dyads.

**Usage**

```
data(dica.ad)
```

**Format**

dica.ad\$data: Seventeen dyads described by 58 variables.  
dica.ad\$design: Seventeen dyads that belong to three groups.

**References**

Williams, L.J., Abdi, H., French, R., & Orange, J.B. (2010). A tutorial on Multi-Block Discriminant Correspondence Analysis (MUDICA): A new method for analyzing discourse data from clinical populations. *Journal of Speech Language and Hearing Research*, **53**, 1372-1393.

---

dica.wine

*Twelve wines from 3 regions in France with 16 attributes.*

---

**Description**

This data should be used for discriminant analyses or analyses where the *group* information is important.

**Usage**

```
data(dica.wine)
```

**Format**

dica.wine\$data: Data matrix with twelve wines (rows) from 3 regions with 16 attributes (columns) in *disjunctive (0/1) coding*.

dica.wine\$design: Design matrix with twelve wines (rows) with 3 regions (columns) to indicate group relationship of the data matrix.

**References**

Abdi, H. (2007). Discriminant correspondence analysis. In N.J. Salkind (Ed.): *Encyclopedia of Measurement and Statistics*. Thousand Oaks (CA): Sage. pp. 270-275.

---

ep.iris

*Fisher's iris Set (for ExPosition)*

---

**Description**

The world famous Fisher's iris set: 150 flowers from 3 species with 4 attributes.

**Usage**

```
data(ep.iris)
```

**Format**

ep.iris\$data: Data matrix with 150 flowers (rows) from 3 species with 4 attributes (columns) describing sepal and petal features.

ep.iris\$design: Design matrix with 150 flowers (rows) with 3 species (columns) indicating which flower belongs to which species.

**Source**

[http://en.wikipedia.org/wiki/Iris\\_flower\\_data\\_set](http://en.wikipedia.org/wiki/Iris_flower_data_set)

---

epCA

*epCA: Correspondence Analysis (CA) via ExPosition.*

---

## Description

Correspondence Analysis (CA) via ExPosition.

## Usage

```
epCA(DATA, DESIGN = NULL, make_design_nominal = TRUE, masses = NULL, weights = NULL,
hellinger = FALSE, symmetric = TRUE, graphs = TRUE, k = 0)
```

## Arguments

DATA	original data to perform a CA on.
DESIGN	a design matrix to indicate if rows belong to groups.
make_design_nominal	a boolean. If TRUE (default), DESIGN is a vector that indicates groups (and will be dummy-coded). If FALSE, DESIGN is a dummy-coded matrix.
masses	a diagonal matrix or column-vector of masses for the row items.
weights	a diagonal matrix or column-vector of weights for the column it
hellinger	a boolean. If FALSE (default), Chi-square distance will be used. If TRUE, Hellinger distance will be used.
symmetric	a boolean. If TRUE (default) symmetric factor scores for rows and columns are computed. If FALSE, the simplex (column-based) will be returned.
graphs	a boolean. If TRUE (default), graphs and plots are provided (via <a href="#">epGraphs</a> )
k	number of components to return.

## Details

epCA performs correspondence analysis. Essentially, a PCA for qualitative data (frequencies, proportions). If you decide to use Hellinger distance, it is best to set `symmetric` to FALSE.

## Value

See [coreCA](#) for details on what is returned.

## Author(s)

Derek Beaton

## References

- Abdi, H., and Williams, L.J. (2010). Principal component analysis. *Wiley Interdisciplinary Reviews: Computational Statistics*, 2, 433-459.
- Abdi, H., and Williams, L.J. (2010). Correspondence analysis. In N.J. Salkind, D.M., Dougherty, & B. Frey (Eds.): *Encyclopedia of Research Design*. Thousand Oaks (CA): Sage. pp. 267-278.
- Abdi, H. (2007). Singular Value Decomposition (SVD) and Generalized Singular Value Decomposition (GSVD). In N.J. Salkind (Ed.): *Encyclopedia of Measurement and Statistics*. Thousand Oaks (CA): Sage. pp. 907-912.
- Greenacre, M. J. (2007). Correspondence Analysis in Practice. *Chapman and Hall*.

## See Also

[coreCA](#), [epMCA](#)

## Examples

```
data(authors)
ca.authors.res <- epCA(authors$ca$data)
```

---

epGPCA	<i>epGPCA: Generalized Principal Components Analysis (GPCA) via ExPosition.</i>
--------	---

---

## Description

Generalized Principal Components Analysis (GPCA) via ExPosition.

## Usage

```
epGPCA(DATA, scale = TRUE, center = TRUE, DESIGN = NULL, make_design_nominal = TRUE,
masses = NULL, weights = NULL, graphs = TRUE, k = 0)
```

## Arguments

DATA	original data to perform a PCA on.
scale	a boolean, vector, or string. See <a href="#">expo.scale</a> for details.
center	a boolean, vector, or string. See <a href="#">expo.scale</a> for details.
DESIGN	a design matrix to indicate if rows belong to groups.
make_design_nominal	a boolean. If TRUE (default), DESIGN is a vector that indicates groups (and will be dummy-coded). If FALSE, DESIGN is a dummy-coded matrix.
masses	a diagonal matrix or column-vector of masses for the row items.
weights	a diagonal matrix or column-vector of weights for the column items.
graphs	a boolean. If TRUE (default), graphs and plots are provided (via <a href="#">epGraphs</a> )
k	number of components to return.

**Details**

epGPCA performs generalized principal components analysis. Essentially, a PCA with masses and weights for rows and columns, respectively.

**Value**

See [corePCA](#) for details on what is returned. In addition to the values in [corePCA](#):

M                    a matrix (or vector, depending on size) of masses for the row items.  
 W                    a matrix (or vector, depending on size) of weights for the column items.

**Author(s)**

Derek Beaton

**References**

Abdi, H., and Williams, L.J. (2010). Principal component analysis. *Wiley Interdisciplinary Reviews: Computational Statistics*, 2, 433-459.  
 Abdi, H. (2007). Singular Value Decomposition (SVD) and Generalized Singular Value Decomposition (GSVD). In N.J. Salkind (Ed.): *Encyclopedia of Measurement and Statistics*. Thousand Oaks (CA): Sage. pp. 907-912.

**See Also**

[corePCA](#), [epPCA](#), [epMDS](#)

**Examples**

```
#this is for ExPosition's iris data
data(ep.iris)
gpca.iris.res <- epGPCA(ep.iris$data,DESIGN=ep.iris$design,make_design_nominal=FALSE)
```

---

 epGraphs

---

*epGraphs: ExPosition plotting function*


---

**Description**

ExPosition plotting function which is an interface to [prettyGraphs](#).

**Usage**

```
epGraphs(res, x_axis = 1, y_axis = 2, epPlotInfo = NULL, DESIGN=NULL,
fi.col = NULL, fi.pch = NULL, fj.col = NULL, fj.pch = NULL, col.offset = NULL,
constraints = NULL, xlab = NULL, ylab = NULL, main = NULL,
contributionPlots = TRUE, correlationPlotter = TRUE,
graphs = TRUE)
```

**Arguments**

res	results from ExPosition
x_axis	which component should be on the x axis?
y_axis	which component should be on the y axis?
epPlotInfo	A list ( <code>\$Plotting.Data</code> ) from epGraphs or ExPosition.
DESIGN	A design matrix to apply colors (by pallete selection) to row items
fi.col	A matrix of colors for the row items. If NULL, colors will be selected.
fi.pch	A matrix of pch values for the row items. If NULL, pch values are all 21.
fj.col	A matrix of colors for the column items. If NULL, colors will be selected.
fj.pch	A matrix of pch values for the column items. If NULL, pch values are all 21.
col.offset	A numeric offset value. Is passed to <code>createColorVectorsByDesign</code> .
constraints	Plot constraints as returned from <code>prettyPlot</code> . If NULL, constraints are selected.
xlab	x axis label
ylab	y axis label
main	main label for the graph window
contributionPlots	a boolean. If TRUE (default), contribution bar plots will be created.
correlationPlotter	a boolean. If TRUE (default), a correlation circle plot will be created. Applies to PCA family of methods (CA is excluded for now).
graphs	a boolean. If TRUE, graphs are created. If FALSE, only data associated to plotting (e.g., constraints, colors) are returned.

**Details**

epGraphs is an interface between `ExPosition` and `prettyGraphs`.

**Value**

The following items are bundled inside of `$Plotting.Data`:

<code>\$fi.col</code>	the colors that are associated to the row items ( <code>\$fi</code> ).
<code>\$fi.pch</code>	the pch values associated to the row items ( <code>\$fi</code> ).
<code>\$fj.col</code>	the colors that are associated to the column items ( <code>\$fj</code> ).
<code>\$fj.pch</code>	the pch values associated to the column items ( <code>\$fj</code> ).
<code>\$constraints</code>	axis constraints for the plots (determines end points of the plots).

**Author(s)**

Derek Beaton

**See Also**[prettyGraphs](#)**Examples**

```
#this is for ExPosition's iris data
data(ep.iris)
pca.iris.res <- epPCA(ep.iris$data)
#this will put plotting data into a new variable.
epGraphs.2.and.3 <- epGraphs(pca.iris.res,x_axis=2,y_axis=3)
```

epMCA

*epMCA: Multiple Correspondence Analysis (MCA) via ExPosition.***Description**

Multiple Correspondence Analysis (MCA) via ExPosition.

**Usage**

```
epMCA(DATA, make_data_nominal = TRUE, DESIGN = NULL, make_design_nominal = TRUE,
masses = NULL, weights = NULL, hellinger = FALSE,
symmetric = TRUE, correction = c("b"), graphs = TRUE, k = 0)
```

**Arguments**

DATA	original data to perform a MCA on. This data can be in original formatting (qualitative levels) or in dummy-coded variables.
make_data_nominal	a boolean. If TRUE (default), DATA is recoded as a dummy-coded matrix. If FALSE, DATA is a dummy-coded matrix.
DESIGN	a design matrix to indicate if rows belong to groups.
make_design_nominal	a boolean. If TRUE (default), DESIGN is a vector that indicates groups (and will be dummy-coded). If FALSE, DESIGN is a dummy-coded matrix.
masses	a diagonal matrix or column-vector of masses for the row items.
weights	a diagonal matrix or column-vector of weights for the column it
hellinger	a boolean. If FALSE (default), Chi-square distance will be used. If TRUE, Hellinger distance will be used.
symmetric	a boolean. If TRUE symmetric factor scores for rows.
correction	which corrections should be applied? "b" = Benzécri correction, "bg" = Greenacre adjustment to Benzécri correction.
graphs	a boolean. If TRUE (default), graphs and plots are provided (via <a href="#">epGraphs</a> )
k	number of components to return.

## Details

epMCA performs multiple correspondence analysis. Essentially, a CA for categorical data. It should be noted that when `hellinger` is selected as `TRUE`, no correction will be performed. Additionally, if you decide to use Hellinger, it is best to set `symmetric` to `FALSE`.

## Value

See [coreCA](#) for details on what is returned. In addition to the values returned:

<code>\$pdq</code>	this is the corrected SVD data, if a correction was selected. If no correction was selected, it is uncorrected.
<code>\$pdq.uncor</code>	uncorrected SVD data.

## Author(s)

Derek Beaton

## References

- Abdi, H., and Williams, L.J. (2010). Principal component analysis. *Wiley Interdisciplinary Reviews: Computational Statistics*, 2, 433-459.
- Abdi, H., and Williams, L.J. (2010). Correspondence analysis. In N.J. Salkind, D.M., Dougherty, & B. Frey (Eds.): *Encyclopedia of Research Design*. Thousand Oaks (CA): Sage. pp. 267-278.
- Abdi, H. (2007). Singular Value Decomposition (SVD) and Generalized Singular Value Decomposition (GSVD). In N.J. Salkind (Ed.): *Encyclopedia of Measurement and Statistics*. Thousand Oaks (CA): Sage. pp. 907-912.
- Benzécri, J. P. (1979). Sur le calcul des taux d'inertie dans l'analyse d'un questionnaire. *Cahiers de l'Analyse des Données*, 4, 377-378.
- Greenacre, M. J. (2007). Correspondence Analysis in Practice. *Chapman and Hall*.

## See Also

[coreCA](#), [epCA](#), [mca.eigen.fix](#)

## Examples

```
data(mca.wine)
mca.wine.res <- epMCA(mca.wine$data)
```



epMDS

*epMDS: Multidimensional Scaling (MDS) via ExPosition.***Description**

Multidimensional Scaling (MDS) via ExPosition.

**Usage**

```
epMDS(DATA, DATA_is_dist = TRUE, method="euclidean", DESIGN = NULL,
make_design_nominal = TRUE, masses = NULL, graphs = TRUE, k = 0)
```

**Arguments**

DATA	original data to perform a MDS on.
DATA_is_dist	a boolean. If TRUE (default) the DATA matrix should be a symmetric distance matrix. If FALSE, a Euclidean distance of row items will be computed and used.
method	which distance metric should be used. method matches <a href="#">dist</a> ; Two additional distances are available: "correlation" and "chi2". For "chi2" see <a href="#">chi2Dist</a> . Default is "euclidean".
DESIGN	a design matrix to indicate if rows belong to groups.
make_design_nominal	a boolean. If TRUE (default), DESIGN is a vector that indicates groups (and will be dummy-coded). If FALSE, DESIGN is a dummy-coded matrix.
masses	a diagonal matrix (or vector) that contains the masses (for the row items).
graphs	a boolean. If TRUE (default), graphs and plots are provided (via <a href="#">epGraphs</a> )
k	number of components to return.

**Details**

epMDS performs metric multi-dimensional scaling. Essentially, a PCA for a symmetric distance matrix.

**Value**

See [coreMDS](#) for details on what is returned. epMDS only returns values related to row items (e.g., fi, ci); no column data is returned.

D the distance matrix that was decomposed. In most cases, it is returned as a squared distance.

**Note**

With respect to input of DATA, epMDS differs slightly from other versions of multi-dimensional scaling.

If you provide a rectangular matrix (e.g., observations x measures), epMDS will compute a distance matrix and square it.

If you provide a distance (dissimilarity) matrix, epMDS does not square it.

**Author(s)**

Derek Beaton

**References**

- Abdi, H. (2007). Metric multidimensional scaling. In N.J. Salkind (Ed.): *Encyclopedia of Measurement and Statistics*. Thousand Oaks (CA): Sage. pp. 598-605.
- O’Toole, A. J., Jiang, F., Abdi, H., and Haxby, J. V. (2005). Partially distributed representations of objects and faces in ventral temporal cortex. *Journal of Cognitive Neuroscience*, 17(4), 580-590.

**See Also**

[corePCA](#), [epPCA](#), [epGPCA](#)

**Examples**

```
data(jocn.2005.fmri)
#by default, components 1 and 2 will be plotted.
mds.res.images <- epMDS(jocn.2005.fmri$images$data)

##iris example
data(ep.iris)
iris.rectangular <- epMDS(ep.iris$data,DATA_is_dist=FALSE)
iris.euc.dist <- dist(ep.iris$data,upper=TRUE,diag=TRUE)
iris.sq.euc.dist <- as.matrix(iris.euc.dist^2)
iris.sq <- epMDS(iris.sq.euc.dist)
```

---

epPCA

*epPCA: Principal Component Analysis (PCA) via ExPosition.*


---

**Description**

Principal Component Analysis (PCA) via ExPosition.

**Usage**

```
epPCA(DATA, scale = TRUE, center = TRUE, DESIGN = NULL, make_design_nominal = TRUE,
graphs = TRUE, k = 0)
```

**Arguments**

DATA	original data to perform a PCA on.
scale	a boolean, vector, or string. See <a href="#">expo.scale</a> for details.
center	a boolean, vector, or string. See <a href="#">expo.scale</a> for details.
DESIGN	a design matrix to indicate if rows belong to groups.

make_design_nominal	a boolean. If TRUE (default), DESIGN is a vector that indicates groups (and will be dummy-coded). If FALSE, DESIGN is a dummy-coded matrix.
graphs	a boolean. If TRUE (default), graphs and plots are provided (via <a href="#">epGraphs</a> )
k	number of components to return.

**Details**

epPCA performs principal components analysis on a data matrix.

**Value**

See [corePCA](#) for details on what is returned.

**Author(s)**

Derek Beaton

**References**

- Abdi, H., and Williams, L.J. (2010). Principal component analysis. *Wiley Interdisciplinary Reviews: Computational Statistics*, 2, 433-459.
- Abdi, H. (2007). Singular Value Decomposition (SVD) and Generalized Singular Value Decomposition (GSVD). In N.J. Salkind (Ed.): *Encyclopedia of Measurement and Statistics*. Thousand Oaks (CA): Sage. pp. 907-912.

**See Also**

[corePCA](#), [epMDS](#), [epGPCA](#)

**Examples**

```
data(words)
pca.words.res <- epPCA(words$data)
```

---

expo.scale                      *Scaling functions for ExPosition.*

---

**Description**

expo.scale is a more elaborate, and complete, version of [scale](#). Several text options are available, but more importantly, the center and scale factors are *always* returned.

**Usage**

```
expo.scale(DATA, center = TRUE, scale = TRUE)
```

**Arguments**

DATA	Data to center, scale, or both.
center	boolean, or (numeric) vector. If boolean or vector, it works just as <a href="#">scale</a> .
scale	boolean, text, or (numeric) vector. If boolean or vector, it works just as <a href="#">scale</a> . The following text options are available: 'z': z-score normalization, 'sd': standard deviation normalization, 'rms': root mean square normalization, 'ssl': sum of squares (of columns) equals 1 normalization.

**Value**

A data matrix that is scaled with the following attributes (see [scale](#)):

<code>\$'scaled:center'</code>	The center of the data. If no center is provided, all 0s will be returned.
<code>\$'scaled:scale'</code>	The scale factor of the data. If no scale is provided, all 1s will be returned.

**Author(s)**

Derek Beaton

---

faces2005

*Faces analyzed using Four Algorithms*

---

**Description**

Four algorithms compared using a distance matrix between six faces.

**Usage**

```
data(faces2005)
```

**Format**

faces2005\$data: A data structure representing a distance matrix (6X6) for four algorithms.

**References**

Abdi, H., & Valentin, D. (2007). DISTATIS: the analysis of multiple distance matrices. *Encyclopedia of Measurement and Statistics*. 284-290.

---

french.social	<i>How twelve French families spend their income on groceries.</i>
---------------	--

---

**Description**

This data should be used with [epPCA](#)

**Usage**

```
data(french.social)
```

**Format**

french.social\$data: Data matrix with twelve families (rows) with 7 attributes (columns) describing what they spend their income on.

**References**

Lebart, L., and Fénelon, J.P. (1975) *Statistique et informatique appliquées*. Paris: Dunod  
 Abdi, H., and Williams, L.J. (2010). Principal component analysis. *Wiley Interdisciplinary Reviews: Computational Statistics*, 2, 433-459.

---

genPDQ	<i>genPDQ: the GSVD</i>
--------	-------------------------

---

**Description**

genPDQ performs the SVD and GSVD for all methods in [ExPosition](#).

**Usage**

```
genPDQ(datain, M = NULL, W = NULL, is.mds = FALSE, decomp.approach = "svd", k = 0)
```

**Arguments**

datain	fully preprocessed data to be decomposed.
M	vector or diagonal matrix of masses (for the rows)
W	vector or diagonal matrix of weights (for the columns)
is.mds	a boolean. If the method is of MDS (e.g., <a href="#">epMDS</a> ), use TRUE. All other methods: FALSE
decomp.approach	a string. Allows for the user to choose which decomposition method to perform. Current options are SVD or Eigen.
k	number of components to return (this is not a rotation, just an <i>a priori</i> selection of how much data should be returned).

**Details**

This function should only be used to create new methods based on the SVD or GSVD.

**Value**

Data of class epSVD which is a list of matrices and vectors:

P	The left singular vectors (rows).
Q	The right singular vectors (columns).
Dv	Vector of the singular values.
Dd	Diagonal matrix of the singular values.
ng	Number of singular values/vectors
rank	Rank of the decomposed matrix. If it is 1, 0s are padded to the above items for plotting purposes.
tau	Explained variance per component

**Author(s)**

Derek Beaton

**See Also**

[pickSVD](#)

---

great.beer.tasting.1 *A collection of beer tasting notes from untrained assessors.*

---

**Description**

A collection of beer tasting notes of 9 beers, across 16 descriptors, from 4 untrained assessors.

**Usage**

```
data(great.beer.tasting.1)
```

**Format**

great.beer.tasting.1\$data: Data matrix (cube). Tasting notes (ratings) of 9 different beers (rows) described by 16 different flavor profiles (columns) by 4 untrained assessors. These data contain NAs and must be imputed or adjusted before an analysis is performed.

great.beer.tasting.1\$brewery.design: Design matrix. Source brewery of 9 different beers (rows) across 5 breweries (columns).

great.beer.tasting.1\$flavor: Design matrix. Intended prominent flavor of 9 different beers (rows) across 3 flavor profiles (columns).

**Source**

Rachel Williams, Jenny Rieck and Derek Beaton recoded, collected data and/or “ran the experiment”.

---

great.beer.tasting.2 *A collection of beer tasting notes from untrained assessors.*

---

**Description**

A collection of beer tasting notes of 13 beers, across 15 descriptors, from 9 untrained assessors.

**Usage**

```
data(great.beer.tasting.2)
```

**Format**

great.beer.tasting.2\$data: Data matrix (cube). Tasting notes (ratings) of 13 different beers (rows) described by 15 different flavor profiles (columns) by 9 untrained assessors. All original values were on an interval scale of 0-5. Any decimal values are imputed from alternate data sources or additional assessors.

great.beer.tasting.2\$brewery.design: Design matrix. Source brewery of 13 different beers (rows) across 13 breweries (columns).

great.beer.tasting.2\$style.design: Design matrix. Style of 13 different beers (rows) across 8 styles (columns). Some complex styles were truncated.

**Source**

Rachel Williams, Jenny Rieck and Derek Beaton recoded, collected data and/or “ran the experiment”.

---

hellingerNorm *Hellinger version of CA preprocessing*

---

**Description**

Performs all steps required for Hellinger form of CA processing (row profile approach).

**Usage**

```
hellingerNorm(X, X_dimensions, colTotal, rowTotal, grandTotal,
weights = NULL, masses = NULL)
```

**Arguments**

X	Data matrix
X_dimensions	The dimensions of X in a vector of length 2 (rows, columns). See <a href="#">dim</a>
colTotal	Vector of column sums.
rowTotal	Vector of row sums.
grandTotal	Grand total of X
weights	Optional weights to include for the columns.
masses	Optional masses to include for the rows.

**Value**

rowCenter	The barycenter of X.
masses	Masses to be used for the GSVD.
weights	Weights to be used for the GSVD.
rowProfiles	The row profiles of X.
deviations	Deviations of row profiles from rowCenter.

**Author(s)**

Derek Beaton and Hervé Abdi

---

hellingerSupplementaryColsPreProcessing  
*Preprocessing for supplementary columns in Hellinger analyses.*

---

**Description**

Preprocessing for supplementary columns in Hellinger analyses.

**Usage**

```
hellingerSupplementaryColsPreProcessing(SUP.DATA, W = NULL, M = NULL)
```

**Arguments**

SUP.DATA	A supplemental matrix that has the same number of rows as an active data set.
W	A vector or matrix of Weights. If none are provided, a default is computed.
M	A vector or matrix of Masses. If none are provided, a default is computed.

**Value**

a matrix that has been preprocessed to project supplementary rows for Hellinger methods.

**Author(s)**

Derek Beaton



---

hellingerSupplementaryRowsPreProcessing  
*Preprocessing for supplementary rows in Hellinger analyses.*

---

**Description**

Preprocessing for supplementary rows in Hellinger analyses.

**Usage**

```
hellingerSupplementaryRowsPreProcessing(SUP.DATA, center = NULL)
```

**Arguments**

SUP.DATA	A supplemental matrix that has the same number of rows as an active data set.
center	The center from the active data. NULL will center SUP.DATA to itself.

**Value**

a matrix that has been preprocessed to project supplementary columns for Hellinger methods.

**Author(s)**

Derek Beaton

---

jlsr.2010.ad                      *Data from 17 Alzheimer's Patient-Spouse dyads.*

---

**Description**

Seventeen Alzheimer's Patient-Spouse Dyads had conversations recorded and 58 attributes were recorded for this data. Each attribute is a frequency of occurrence of the item.

**Usage**

```
data(jlsr.2010.ad)
```

**Format**

jlsr.2010.ad\$ca\$data: Seventeen patient-spouse dyads (rows) described by 58 conversation items. For use with [epCA](#) and discriminant analyses.  
jlsr.2010.ad\$mca\$design: A design matrix that indicates which group the dyad belongs to: control (CTRL), early stage Alzheimer's (EDAT) or middle stage Alzheimer's (MDAT).

**References**

Williams, L.J., Abdi, H., French, R., and Orange, J.B. (2010). A tutorial on Multi-Block Discriminant Correspondence Analysis (MUDICA): A new method for analyzing discourse data from clinical populations. *Journal of Speech Language and Hearing Research*, 53, 1372-1393.

---

jocn.2005.fmri

*Data of categories of images as view in an fMRI experiment.*

---

**Description**

Contains 2 data sets: distance matrix of *fMRI* scans of participants viewing categories of items and distance matrix of the actual pixels from the images in each category.

**Usage**

```
data(jocn.2005.fmri)
```

**Format**

jocn.2005.fmri\$images\$data: A distance matrix of 6 categories of images based on a pixel analysis.  
 jocn.2005.fmri\$scans\$data: A distance matrix of 6 categories of images based on *fMRI* scans.

**References**

O'Toole, A. J., Jiang, F., Abdi, H., and Haxby, J. V. (2005). Partially distributed representations of objects and faces in ventral temporal cortex. *Journal of Cognitive Neuroscience*, 17(4), 580-590.  
 Haxby, J. V., Gobbini, M. I., Furey, M. L., Ishai, A., Schouten, J. L., and Pietrini, P. (2001). Distributed and overlapping representation of faces and objects in ventral temporal cortex. *Science*, 293, 2425-2430.

**See Also**

<http://openfmri.org/dataset/ds000105>

---

makeDistancesAndWeights

*Makes distances and weights for MDS analyses (see epMDS).*

---

**Description**

Makes distances and weights for MDS analyses (see [epMDS](#)).

**Usage**

```
makeDistancesAndWeights(DATA, method = "euclidean", masses = NULL)
```

**Arguments**

DATA	A data matrix to compute distances between row items.
method	which distance metric should be used. method matches <a href="#">dist</a> ; Two additional distances are available: "correlation" and "chi2". For "chi2" see <a href="#">chi2Dist</a> . Default is "euclidean".
masses	a diagonal matrix (or vector) that contains the masses (for the row items).

**Value**

D	Distance matrix for analysis
MW	a list item with masses and weights. Weights are not used in <a href="#">epMDS</a> .

**Author(s)**

Derek Beaton

**See Also**

[link{computeMW}](#), [link{epMDS}](#), [link{coreMDS}](#)

---

makeNominalData

*makeNominalData*

---

**Description**

Transforms each column into measure-response columns with disjunctive (0/1) coding. If NA is found somewhere in matrix, barycentric recoding is performed for the missing value(s).

**Usage**

```
makeNominalData(datain)
```

**Arguments**

datain            a data matrix where the *columns* will be recoded.

**Value**

dataout           a transformed version of *datain*.

**Author(s)**

Derek Beaton

**See Also**

[epMCA](#)

**Examples**

```
data(mca.wine)
nominal.wine <- makeNominalData(mca.wine$data)
```

---

makeRowProfiles	<i>Preprocessing for CA-based analyses</i>
-----------------	--

---

**Description**

This function performs all preprocessing steps required for Correspondence Analysis-based preprocessing.

**Usage**

```
makeRowProfiles(X, weights = NULL, masses = NULL, hellinger = FALSE)
```

**Arguments**

X	Data matrix.
weights	optional. Weights to include in preprocessing.
masses	optional. Masses to include in preprocessing.
hellinger	a boolean. If TRUE, Hellinger preprocessing is used. Else, CA row profile is computed.

**Value**

Returns from `link{hellingerNorm}` or `caNorm`.

**Author(s)**

Derek Beaton

---

mca.eigen.fix	<i>mca.eigen.fix</i>
---------------	----------------------

---

**Description**

A function for correcting the eigenvalues and output from multiple correspondence analysis (MCA, `epMCA`)

**Usage**

```
mca.eigen.fix(DATA, mca.results, make_data_nominal = TRUE, numVariables = NULL,
correction = c("b"), symmetric = FALSE)
```

**Arguments**

DATA	original data (i.e., not transformed into disjunctive coding)
mca.results	output from <a href="#">epMCA</a>
make_data_nominal	a boolean. Should <i>DATA</i> be transformed into disjunctive coding? Default is TRUE.
numVariables	the number of actual measures/variables in the data (typically the number of columns in <i>DATA</i> )
correction	which corrections should be applied? "b" = Benzécri correction, "bg" = Greenacre adjustment to Benzécri correction.
symmetric	a boolean. If the results from MCA are symmetric or asymmetric factor scores. Default is FALSE.

**Value**

mca.results	a modified version of mca.results. Factor scores (e.g., \$fi, \$fj), and \$pdq are updated based on corrections chosen.
-------------	---

**Author(s)**

Derek Beaton

**References**

- Benzécri, J. P. (1979). Sur le calcul des taux d'inertie dans l'analyse d'un questionnaire. *Cahiers de l'Analyse des Données*, **4**, 377-378.
- Greenacre, M. J. (2007). *Correspondence Analysis in Practice*. *Chapman and Hall*.

**See Also**

[epMCA](#)

**Examples**

```
data(mca.wine)
#No corrections used in MCA
mca.wine.res.uncor <- epMCA(mca.wine$data,correction=NULL)
data <- mca.wine$data
expo.output <- mca.wine.res.uncor$ExPosition.Data
#mca.eigen.fix with just Benzécri correction
mca.wine.res.b <- mca.eigen.fix(data, expo.output,correction=c('b'))
#mca.eigen.fix with Benzécri + Greenacre adjustment
mca.wine.res.bg <- mca.eigen.fix(data,expo.output,correction=c('b','g'))
```

mca.wine

*Six wines described by several assessors with qualitative attributes.*

---

### Description

Six wines described by several assessors with qualitative attributes.

### Usage

```
data(mca.wine)
```

### Format

mca.wine\$data: A (categorical) data matrix with 6 wines (rows) from several assessors described by 10 attributes (columns). For use with [epMCA](#).

### References

Abdi, H., & Valentin, D. (2007). Multiple correspondence analysis. In N.J. Salkind (Ed.): *Encyclopedia of Measurement and Statistics*. Thousand Oaks (CA): Sage. pp. 651-657.

---

mdsSupplementalElementsPreProcessing

*MDS preprocessing*

---

### Description

Preprocessing of supplemental data for MDS analyses.

### Usage

```
mdsSupplementalElementsPreProcessing(SUP.DATA = NULL, D = NULL, M = NULL)
```

### Arguments

SUP.DATA	A supplementary data matrix.
D	The original (active) distance matrix that SUP.DATA is supplementary to.
M	masses from the original (active) analysis for D.

### Value

a matrix that is preprocessed for supplementary projection in MDS.

### Author(s)

Derek Beaton

---

mdsTransform	<i>Transform data for MDS analysis.</i>
--------------	---

---

**Description**

Transform data for MDS analysis.

**Usage**

```
mdsTransform(D, masses)
```

**Arguments**

D	A distance matrix
masses	A vector or matrix of masses (see computeMW).

**Value**

S	a preprocessed matrix that can be decomposed.
---	---

**Author(s)**

Derek Beaton

---

nominalCheck	<i>Checks if data are disjunctive.</i>
--------------	--

---

**Description**

Checks if data is in disjunctive (sometimes called complete binary) format. To be used with MCA (e.g., [epMCA](#)).

**Usage**

```
nominalCheck(DATA)
```

**Arguments**

DATA	A data matrix to check. This should be 0/1 disjunctive coded. nominalCheck just checks to make sure it is complete.
------	---

**Value**

If DATA are nominal, DATA is returned. If not, [stop](#) is called and execution halts.

**Author(s)**

Derek Beaton

---

pause	<i>pause</i>
-------	--------------

---

**Description**

A replication of MatLab pause function.

**Usage**

```
pause(x = 0)
```

**Arguments**

x optional. If  $x > 0$  a call is made to [Sys.sleep](#). Else, execution pauses until a key is entered.

**Author(s)**

Derek Beaton (but the pase of which is provided by Phillippe Brosjean from the R mailing list.)

**References**

Copied from:  
<https://stat.ethz.ch/pipermail/r-help/2001-November/>

---

pca.wine	<i>Six wines described by several assessors with rank attributes.</i>
----------	---

---

**Description**

Six wines described by several assessors with rank attributes.

**Usage**

```
data(pca.wine)
```

**Format**

pca.wine\$data: A data matrix with 6 wines (rows) from several assessors described by 11 attributes (columns). For use with [epPCA](#).

**References**

Abdi, H., and Williams, L.J. (2010). Principal component analysis. *Wiley Interdisciplinary Reviews: Computational Statistics*, 2, 433-459.

**See Also**

[mca.wine](#)



---

pcaSupplementaryColsPreProcessing

*Preprocessing for supplementary columns in PCA.*

---

**Description**

Preprocessing for supplementary columns in PCA.

**Usage**

```
pcaSupplementaryColsPreProcessing(SUP.DATA = NULL, center = TRUE, scale = TRUE, M = NULL)
```

**Arguments**

SUP.DATA	A supplemental matrix that has the same number of rows as an active data set.
center	The center from the active data. NULL will center SUP.DATA to itself.
scale	The scale factor from the active data. NULL will scale (z-score) SUP.DATA to itself.
M	Masses from the active data. Used in <a href="#">epGPCA</a> .

**Value**

a matrix that has been preprocessed to project supplementary columns for PCA methods.

**Author(s)**

Derek Beaton

---

pcaSupplementaryRowsPreProcessing

*Preprocessing for supplemental rows in PCA.*

---

**Description**

Preprocessing for supplemental rows in PCA.

**Usage**

```
pcaSupplementaryRowsPreProcessing(SUP.DATA = NULL, center = TRUE, scale = TRUE, W = NULL)
```

**Arguments**

SUP.DATA	A supplemental matrix that has the same number of columns as an active data set.
center	The center from the active data. NULL will center SUP.DATA to itself.
scale	The scale factor from the active data. NULL will scale (z-score) SUP.DATA to itself.
W	Weights from the active data. Used in <a href="#">epGPCA</a> .

**Value**

a matrix that has been preprocessed to project supplementary rows for PCA methods.

**Author(s)**

Derek Beaton

---

pickSVD *Pick which generalized SVD (or related) decomposition to use.*

---

**Description**

This function is an interface for the user to a general SVD or related decomposition. It provides direct access to [svd](#) and [eigen](#). Future decompositions will be available.

**Usage**

```
pickSVD(datain, is.mds = FALSE, decomp.approach = "svd", k = 0)
```

**Arguments**

datain	a data matrix to decompose.
is.mds	a boolean. TRUE for a MDS decomposition.
decomp.approach	a string. 'svd' for singular value decomposition, 'eigen' for an eigendecomposition. All approaches provide identical output. Some approaches are (in some cases) faster than others.
k	numeric. The number of components to return.

**Value**

A list with the following items:

u	Left singular vectors (rows)
v	Right singular vectors (columns)
d	Singular values
tau	Explained variance per component

**Author(s)**

Derek Beaton

---

print.epCA

*Print Correspondence Analysis (CA) results*

---

**Description**

Print Correspondence Analysis (CA) results.

**Usage**

```
## S3 method for class 'epCA'  
print(x,...)
```

**Arguments**

x                    an list that contains items to make into the epCA class.  
...                  inherited/passed arguments for S3 print method(s).

**Author(s)**

Derek Beaton and Cherise Chin-Fatt

---

print.epGPCA

*Print Generalized Principal Components Analysis (GPCA) results*

---

**Description**

Print Generalized Principal Components Analysis (GPCA) results.

**Usage**

```
## S3 method for class 'epGPCA'  
print(x,...)
```

**Arguments**

x                    an list that contains items to make into the epGPCA class.  
...                  inherited/passed arguments for S3 print method(s).

**Author(s)**

Derek Beaton and Cherise Chin-Fatt

---

print.epGraphs            *Print epGraphs results*

---

**Description**

Print epGraphs results.

**Usage**

```
## S3 method for class 'epGraphs'  
print(x,...)
```

**Arguments**

x                    an list that contains items to make into the epGraphs class.  
...                  inherited/passed arguments for S3 print method(s).

**Author(s)**

Derek Beaton and Cherise Chin-Fatt

**See Also**

[epGraphs](#)

---

print.epMCA            *Print Multiple Correspondence Analysis (MCA) results*

---

**Description**

Print Multiple Correspondence Analysis (MCA) results.

**Usage**

```
## S3 method for class 'epMCA'  
print(x,...)
```

**Arguments**

x                    an list that contains items to make into the epMCA class.  
...                  inherited/passed arguments for S3 print method(s).

**Author(s)**

Derek Beaton and Cherise Chin-Fatt

---

print.epMDS	<i>Print Multidimensional Scaling (MDS) results</i>
-------------	---

---

**Description**

Print Multidimensional Scaling (MDS) results.

**Usage**

```
## S3 method for class 'epMDS'  
print(x,...)
```

**Arguments**

x	an list that contains items to make into the epMDS class.
...	inherited/passed arguments for S3 print method(s).

**Author(s)**

Derek Beaton and Cherise Chin-Fatt

---

print.epPCA	<i>Print Principal Components Analysis (PCA) results</i>
-------------	--

---

**Description**

Print Principal Components Analysis (PCA) results.

**Usage**

```
## S3 method for class 'epPCA'  
print(x,...)
```

**Arguments**

x	an list that contains items to make into the epPCA class.
...	inherited/passed arguments for S3 print method(s).

**Author(s)**

Derek Beaton and Cherise Chin-Fatt

---

print.epSVD	<i>Print results from the singular value decomposition (SVD) in ExPosition</i>
-------------	--

---

**Description**

Print results from the singular value decomposition (SVD) in ExPosition.

**Usage**

```
## S3 method for class 'epSVD'
print(x,...)
```

**Arguments**

x	an list that contains items to make into the epSVD class.
...	inherited/passed arguments for S3 print method(s).

**Author(s)**

Derek Beaton and Cherise Chin-Fatt

---

print.expoOutput	<i>Print results from ExPosition</i>
------------------	--------------------------------------

---

**Description**

Print results from the ExPosition. Includes results from a given method and epGraphs.

**Usage**

```
## S3 method for class 'expoOutput'
print(x,...)
```

**Arguments**

x	an list that contains items to make into the expoOutput class.
...	inherited/passed arguments for S3 print method(s).

**Author(s)**

Derek Beaton and Cherise Chin-Fatt

**See Also**

[epPCA](#), [epGraphs](#)

---

rowNorms	<i>Normalize the rows of a matrix.</i>
----------	--

---

**Description**

This function will normalize the rows of a matrix.

**Usage**

```
rowNorms(X, type = NULL, center = FALSE, scale = FALSE)
```

**Arguments**

X	Data matrix
type	a string. Type of normalization to perform. Options are hellinger, ca, z, other
center	optional. A vector to center the columns of X.
scale	optional. A vector to scale the values of X.

**Details**

rowNorms works like `link{expo.scale}`, but for rows. Hellinger row norm via `hellinger`, Correspondence analysis analysis row norm (row profiles) via `ca`, Z-score row norm via `z`. `other` passes `center` and `scale` to `expo.scale` and allows for optional centering and scaling parameters.

**Value**

Returns a row normalized version of X.

**Author(s)**

Derek Beaton

---

rvCoeff	<i>Perform Rv coefficient computation.</i>
---------	--

---

**Description**

Perform Rv coefficient computation.

**Usage**

```
rvCoeff(Smat, Tmat, type)
```

**Arguments**

Smat	A square covariance matrix
Tmat	A square covariance matrix
type	DEPRECATED. Any value here will be ignored

**Value**

A single value that is the Rv coefficient.

**Author(s)**

Derek Beaton

**References**

Robert, P., & Escoufier, Y. (1976). A Unifying Tool for Linear Multivariate Statistical Methods: The RV-Coefficient. *Journal of the Royal Statistical Society. Series C (Applied Statistics)*, 25(3), 257–265.

---

snps.druguse

*Small data set for Partial Least Squares-Correspondence Analysis*

---

**Description**

The data come from a larger study on marijuana dependent individuals (see Filbey et al., 2009) and are illustrated in Beaton et al., 2013.

The data contain 2 genetic markers and 3 additional drug use questions from 50 marijuana dependent individuals.

**Usage**

```
data(snps.druguse)
```

**Format**

snps.druguse\$DATA1: Fifty marijuana dependent participants indicated which, if any, other drugs they have ever used.

snps.druguse\$DATA2: Fifty marijuana dependent participants were genotyped for the COMT and FAAH genes.

**Details**

In snps.druguse\$DATA1:

e - Stands for ecstasy use. Responses are yes or no. cc - Stands for crack/cocaine use. Responses are yes or no. cm - Stands for crystal meth use. Responses are yes or no.

In snps.druguse\$DATA2:

COMT - Stands for the COMT gene. Alleles are AA, AG, or GG. Some values are NA. FAAH - Stands for FAAH gene. Alleles are AA, CA, CC. Some values are NA.



## References

- Filbey, F. M., Schacht, J. P., Myers, U. S., Chavez, R. S., & Hutchison, K. E. (2009). Marijuana craving in the brain. *Proceedings of the National Academy of Sciences*, 106(31), 13016 – 13021.
- Beaton D., Filbey F. M., Abdi H. (2013, in press). Integrating Partial Least Squares Correlation and Correspondence Analysis for Nominal Data. In Abdi H, Chin W, Esposito-Vinzi V, Russolillo G, Trinchera L. *Proceedings in Mathematics and Statistics (Vol. 56): New Perspectives in Partial Least Squares and Related Methods*. New York, NY: Springer-Verlag.

---

supplementalProjection

*Supplemental projections.*

---

## Description

Performs a supplementary projection across ExPosition (and related) techniques.

## Usage

```
supplementalProjection(sup.transform = NULL, f.scores = NULL, Dv = NULL,
  scale.factor = NULL, symmetric = TRUE)
```

## Arguments

- |               |  |
|---------------|--|
| sup.transform | Data already transformed for supplementary projection. That is, the output from: <a href="#">caSupplementalElementsPreProcessing</a> , <a href="#">mdsSupplementalElementsPreProcessing</a> , <a href="#">pcaSupplementaryColsPreProcessing</a> , or <a href="#">pcaSupplementaryRowsPreProcessing</a> . |
| f.scores      | Active factor scores, e.g., <code>res\$ExPosition.Data\$fi</code>  |
| Dv            | Active singular values, e.g., <code>res\$ExPosition.Data\$pdq\$Dv</code>   |
| scale.factor  | allows for a scaling factor of supplementary projections. Primarily used for MCA supplementary projections to a correction (e.g., Benzecri).   |
| symmetric     | a boolean. Default is TRUE. If FALSE, factor scores are computed with asymmetric properties (for rows only).   |

## Value

A list with:

- |       |                                 |
|-------|---------------------------------|
| f.out | Supplementary factor scores.    |
| d.out | Supplementary square distances. |
| r.out | Supplementary cosines.          |

## Author(s)

Derek Beaton

**See Also**

It is preferred for users to compute supplemental projections via [supplementaryRows](#) and [supplementaryCols](#). These handle some of the nuances and subtleties due to the different methods.

---

supplementaryCols	<i>Supplementary columns</i>
-------------------	------------------------------

---

**Description**

Computes factor scores for supplementary measures (columns).

**Usage**

```
supplementaryCols(SUP.DATA, res, center = TRUE, scale = TRUE)
```

**Arguments**

SUP.DATA	a data matrix of supplementary measures (must have the same observations [rows] as active data)
res	ExPosition or TExPosition results
center	a boolean, string, or numeric. See <a href="#">expo.scale</a>
scale	a boolean, string, or numeric. See <a href="#">expo.scale</a>

**Details**

This function recognizes the class types of: [epPCA](#), [epGPCA](#), [epMDS](#), [epCA](#), [epMCA](#), and [TExPosition](#) methods. Further, the function recognizes if Hellinger (as opposed to row profiles; in CA, MCA and DICA) were used.

**Value**

A list of values containing:

fjj	factor scores computed for supplemental columns
djj	squared distances for supplemental columns
rjj	cosines for supplemental columns

**Author(s)**

Derek Beaton

---

supplementaryRows	<i>Supplementary rows</i>
-------------------	---------------------------

---

**Description**

Computes factor scores for supplementary observations (rows).

**Usage**

```
supplementaryRows(SUP.DATA, res)
```

**Arguments**

SUP.DATA	a data matrix of supplementary observations (must have the same measures [columns] as active data)
res	ExPosition or TExPosition results

**Details**

This function recognizes the class types of: `epPCA`, `epGPCA`, `epMDS`, `epCA`, `epMCA` and `TExPosition` methods. Further, the function recognizes if Hellinger (as opposed to row profiles; in CA, MCA and DICA) were used.

**Value**

A list of values containing:

<code>fii</code>	factor scores computed for supplemental observations
<code>dii</code>	squared distances for supplemental observations
<code>rii</code>	cosines for supplemental observations

**Author(s)**

Derek Beaton

---

wines2007

*Six wines described by 3 assessors.*

---

**Description**

How six wines are described by 3 assessors across various flavor profiles, totaling 10 columns.

**Usage**

```
data(wines2007)
```

**Format**

wines2007\$data: A data set with 3 experts (studies) describing 6 wines (rows) using several variables using a scale from 1 to 7 with a total of 10 measures (columns).

wines2007\$table: A data matrix which identifies the 3 experts (studies).

**References**

Abdi, H., & Valentin, D. (2007). STATIS. In N.J. Salkind (Ed.): *Encyclopedia of Measurement and Statistics*. Thousand Oaks (CA): Sage. pp. 955-962.

---

wines2012

*Wines Data from 12 assessors described by 15 flavor profiles.*

---

**Description**

10 experts who describe 12 wines using four variables (cat-pee, passion fruit, green pepper, and mineral) considered as standard, and up to two additional variables if the experts chose.

**Usage**

```
data(wines2012)
```

**Format**

wines2012\$data: A data set with 10 experts (studies) describing 12 wines (rows) using four to six variables using a scale from 1 to 9 with a total of 53 measures (columns).

wines2012\$table: A data matrix which identifies the 10 experts (studies).

wines2012\$supplementary: A data matrix with 12 wines (rows) describing 4 Chemical Properties (columns).

**References**

Abdi, H., Williams, L.J., Valentin, D., & Bennani-Dosse, M. (2012). STATIS and DISTATIS: Optimum multi-table principal component analysis and three way metric multidimensional scaling. *Wiley Interdisciplinary Reviews: Computational Statistics*, 4, 124-167.

---

words

*Twenty words described by 2 features.*

---

**Description**

Twenty words “randomly” selected from a dictionary and described by two features: length of word and number of definitions.

**Usage**

`data(words)`

**Format**

`words`\$data: A data matrix with 20 words (rows) described by 2 attributes (columns). For use with [epPCA](#).

**References**

Abdi, H., and Williams, L.J. (2010). Principal component analysis. *Wiley Interdisciplinary Reviews: Computational Statistics*, 2, 433-459.

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