Package 'rrr'

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Title Reduced-Rank Regression

Version 1.0.0

URL http://github.com/chrisaddy/rrr

Description Reduced-rank regression, diagnostics and graphics.

Depends R (>= 3.2.0)

Imports Rcpp, MASS, magrittr, dplyr, ggplot2, plotly, GGally

Suggests testthat, knitr, rmarkdown, readr

Collate utility_functions.R reduce_rank_regression.R pca.R cva.R lda.R rrr.R data.R

License GPL-3

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LazyData true

RoxygenNote 5.0.1

VignetteBuilder knitr

NeedsCompilation no

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Repository CRAN

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Contents

`COMBO17` *MMST COMBO17 DATA*

Description

COMBO-17 galaxy photometric catalogue, 216, 219, 235

Usage

```
COMBO17
```

Format

A data frame with 3462 observations on 65 numeric variables.

References

A. Izenman (2008). *Modern Multivariate Statistical Techniques*. Springer.

Wolf, C. Meisenheimer, M., Kleinheinrich, M., Borch, A., Dye, S., Gray, M., Wisotski, L., Bell, E.F., Rix, H., W. Cimatti, A., Hasinger, G., and Szokoly, G. (2004). *A catalogue of the Chandra Deep Field South with multi-colour classification and photometric redshifts from COMBO-17, Astronomy & Astrophysics*. https://arxiv.org/pdf/astro-ph/0403666.pdf

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`pairwise_plot` *Pairwise Plots*

Description

Pairwise Plots

Usage

```
pairwise_plot(x, y, type = "pca", pair_x = 1, pair_y = 2, rank = "full",
  k = 0, interactive = FALSE, point_size = 2.5)
```

Arguments

`x`	data frame or matrix of predictor variables
`y`	data frame or matrix of response variables
`type`	type of reduced-rank regression model to fit. `type = "identity"`, the default, uses $\mathbf{\Gamma} = \mathbf{I}$ to fit a reduced-rank regression. `type = "pca"` fits a principal component analysis model as a special case of reduced-rank regression. `type = "cva"` fits a canonical variate analysis model as a special case of reduced-rank regression. `type = "lda"` fits a linear discriminant analysis model as a special case of reduced-rank regression.

pair_x	variable to be plotted on the X-axis
pair_y	variable to be plotted on the Y-axis
rank	rank of coefficient matrix.
k	small constant added to diagonal of covariance matrices to make inversion easier.
interactive	logical. If interactive = FALSE, the default, plots a static pairwise plot. If interactive = FALSE plots an interactive pairwise plot.
point_size	size of points in scatter plot.

Value

ggplot2 object if interactive = FALSE; plotly object if interactive = TRUE.

References

Izenman, A.J. (2008) *Modern Multivariate Statistical Techniques*. Springer.

Examples

```
data(pendigits)
digits_features <- pendigits[,1:34]
digits_class <- pendigits[,35]
pairwise_plot(digits_features, digits_class, type = "pca", pair_x = 1, pair_y = 3)

library(dplyr)
data(COMBO17)
galaxy <- as_data_frame(COMBO17)
galaxy <- select(galaxy, -starts_with("e."), -Nr, -UFS:-IFD)
galaxy <- na.omit(galaxy)
galaxy_x <- select(galaxy, -Rmag:-chi2red)
galaxy_y <- select(galaxy, Rmag:chi2red)
pairwise_plot(galaxy_x, galaxy_y, type = "cva")

data(iris)
iris_x <- iris[,1:4]
iris_y <- iris[5]
pairwise_plot(iris_x, iris_y, type = "lda")
```

---

pendigits *MMST PENDIGITS DATA*

Description

pen-based handwritten digit recognition, 211, 234, 274, 348, 391, 631

Usage

```
pendigits
```

Format

a data frame with 10992 observations on 36 unnamed variables

Source

http://archive.ics.uci.edu/ml/datasets.html

References

A. Izenman (2008) *Modern Multivariate Statistical Techniques*. Springer.

`rank_trace` *Rank Trace Plot*

Description

`rank_trace` is a plot used to determine the effective dimensionality, i.e., $t = \text{rank}\,(\mathbf{C})$, of the reduced-rank regression equation.

Usage

```
rank_trace(x, y, type = "identity", k = 0, plot = TRUE,
  interactive = FALSE)
```

Arguments

`x`	data frame or matrix of predictor variables
`y`	data frame or matrix of response variables
`type`	type of reduced-rank regression model to fit. `type = "identity"`, the default, uses $\mathbf{\Gamma} = \mathbf{I}$ to fit a reduced-rank regression. `type = "pca"` fits a principal component analysis model as a special case of reduced-rank regression. `type = "cva"` fits a canonical variate analysis model as a special case of reduced-rank regression. `type = "lda"` fits a linear discriminant analysis model as a special case of reduced-rank regression.
`k`	small constant added to diagonal of covariance matrices to make inversion easier.
`plot`	if FALSE, returns data frame of rank trace coordinates.
`interactive`	if TRUE, creates an interactive plotly graphic.

Value

plot of rank trace coordinates if `plot = TRUE`, the default, or data frame of rank trace coordinates if `plot = FALSE`.

References

Izenman, A.J. (2008) *Modern Multivariate Statistical Techniques*. Springer.

Examples

```
data(tobacco)
tobacco_x <- tobacco[,4:9]
tobacco_y <- tobacco[,1:3]
gamma <- diag(1, dim(tobacco_y)[2])
rank_trace(tobacco_x, tobacco_y)
rank_trace(tobacco_x, tobacco_y, plot = FALSE)
rank_trace(tobacco_x, tobacco_y, type = "cva")

data(pendigits)
digits_features <- pendigits[, -35:-36]
rank_trace(digits_features, digits_features, type = "pca")

library(dplyr)
data(COMBO17)
galaxy <- as_data_frame(COMBO17)
galaxy <- select(galaxy, -starts_with("e."), -Nr, -UFS:-IFD)
galaxy <- na.omit(galaxy)
galaxy_x <- select(galaxy, -Rmag:-chi2red)
galaxy_y <- select(galaxy, Rmag:chi2red)
rank_trace(galaxy_x, galaxy_y, type = "cva")
```

`residuals` *Reduced-Rank Regression Residuals*

Description

`residuals` calculates the regression residuals for reduced-rank regression and canonical variate analysis.

Usage

```
residuals(x, y, type = "identity", rank = "full", k = 0, plot = TRUE)
```

Arguments

`x`	data frame or matrix of predictor variables
`y`	data frame or matrix of response variables
`type`	type of reduced-rank regression model to fit. `type = "identity"`, the default, uses $\mathbf{\Gamma} = \mathbf{I}$ to fit a reduced-rank regression. `type = "pca"` fits a principal component analysis model as a special case of reduced-rank regression. `type = "cva"` fits a canonical variate analysis model as a special case of reduced-rank regression. `type = "lda"` fits a linear discriminant analysis model as a special case of reduced-rank regression.
`rank`	rank of coefficient matrix.
`k`	small constant added to diagonal of covariance matrices to make inversion easier.
`plot`	if FALSE, returns data frame of rank trace coordinates.

Value

scatterplot matrix of residuals if `plot = TRUE`, the default, or a data frame of residuals if `plot = FALSE`.

References

Izenman, A.J. (2008) *Modern Multivariate Statistical Techniques*. Springer.

Examples

```
data(tobacco)
tobacco_x <- tobacco[,4:9]
tobacco_y <- tobacco[,1:3]
tobacco_rrr <- rrr(tobacco_x, tobacco_y, rank = 1)
residuals(tobacco_x, tobacco_y, rank = 1, plot = FALSE)
residuals(tobacco_x, tobacco_y, rank = 1)

library(dplyr)
data(COMBO17)
galaxy <- as_data_frame(COMBO17)
galaxy <- select(galaxy, -starts_with("e."), -Nr, -UFS:-IFD)
galaxy <- na.omit(galaxy)
galaxy_x <- select(galaxy, -Rmag:-chi2red)
galaxy_y <- select(galaxy, Rmag:chi2red)
residuals(galaxy_x, galaxy_y, type = "cva", rank = 2, k = 0.001)
```

---

rrr *Fit Reduced-Rank Regression Model*

Description

`rrr` fits a reduced-rank regression model.

Usage

```
rrr(x, y, type = "identity", rank = "full", k = 0)
```

Arguments

`x`	data frame or matrix of predictor variables
`y`	data frame or matrix of response variables
`type`	type of reduced-rank regression model to fit. `type = "identity"`, the default, uses $\mathbf{\Gamma} = \mathbf{I}$ to fit a reduced-rank regression. `type = "pca"` fits a principal component analysis model as a special case of reduced-rank regression. `type = "cva"` fits a canonical variate analysis model as a special case of reduced-rank regression. `type = "lda"` fits a linear discriminant analysis model as a special case of reduced-rank regression.

rank	rank of coefficient matrix.
k	small constant added to diagonal of covariance matrices to make inversion easier.

Value

list containing estimates of coefficients and means, and eigenvalue-based diagnostics.

References

Izenman, A.J. (2008) *Modern Multivariate Statistical Techniques*. Springer.

Examples

```
data(tobacco)
tobacco_x <- tobacco[,4:9]
tobacco_y <- tobacco[,1:3]
rrr(tobacco_x, tobacco_y, rank = 1)

data(pendigits)
digits_features <- pendigits[, -35:-36]
rrr(digits_features, digits_features, type = "pca", rank = 3)

library(dplyr)
data(COMBO17)
galaxy <- as_data_frame(COMBO17)
galaxy <- select(galaxy, -starts_with("e."), -Nr, -UFS:-IFD)
galaxy <- na.omit(galaxy)
galaxy_x <- select(galaxy, -Rmag:-chi2red)
galaxy_y <- select(galaxy, Rmag:chi2red)
rrr(galaxy_x, galaxy_y, type = "cva", rank = 2)

data(iris)
iris_x <- iris[,1:4]
iris_y <- iris[5]
rrr(iris_x, iris_y, type = "lda")
```

---

scores *Compute Latent Variable Scores*

Description

Compute Latent Variable Scores

Usage

```
scores(x, y, type = "pca", rank = "full", k = 0)
```

Arguments

x	data frame or matrix of predictor variables
y	data frame or matrix of response variables
type	type of reduced-rank regression model to fit. type = "identity", the default, uses $\mathbf{\Gamma} = \mathbf{I}$ to fit a reduced-rank regression. type = "pca" fits a principal component analysis model as a special case of reduced-rank regression. type = "cva" fits a canonical variate analysis model as a special case of reduced-rank regression. type = "lda" fits a linear discriminant analysis model as a special case of reduced-rank regression.
rank	rank of coefficient matrix.
k	small constant added to diagonal of covariance matrices to make inversion easier.

References

Izenman, A.J. (2008) *Modern Multivariate Statistical Techniques*. Springer.

Examples

```
data(pendigits)
digits_features <- pendigits[, -35:-36]
scores(digits_features, digits_features, type = "pca", rank = 3)

library(dplyr)
data(COMBO17)
galaxy <- as_data_frame(COMBO17)
galaxy <- select(galaxy, -starts_with("e."), -Nr, -UFS:-IFD)
galaxy <- na.omit(galaxy)
galaxy_x <- select(galaxy, -Rmag:-chi2red)
galaxy_y <- select(galaxy, Rmag:chi2red)
scores(galaxy_x, galaxy_y, type = "cva", rank = 4)

data(iris)
iris_x <- iris[,1:4]
iris_y <- iris[5]
scores(iris_x, iris_y, type = "lda")
```

---

threewise_plot *3-D Reduced Rank Regression Plots*

Description

Create three-dimensional, interactive plotly graphics for exploration and diagnostics.

Usage

```
threewise_plot(x, y, type = "pca", pair_x = 1, pair_y = 2, pair_z = 3,
  rank = "full", k = 0, point_size = 2.5)
```

Arguments

x	data frame or matrix of predictor variables
y	data frame or matrix of response variables
type	type of reduced-rank regression model to fit. type = "identity", the default, uses $\mathbf{\Gamma} = \mathbf{I}$ to fit a reduced-rank regression. type = "pca" fits a principal component analysis model as a special case of reduced-rank regression. type = "cva" fits a canonical variate analysis model as a special case of reduced-rank regression. type = "lda" fits a linear discriminant analysis model as a special case of reduced-rank regression.
pair_x	variable to be plotted on the X-axis
pair_y	variable to be plotted on the Y-axis
pair_z	variable to be plotted on the Z-axis
rank	rank of coefficient matrix.
k	small constant added to diagonal of covariance matrices to make inversion easier.
point_size	size of points in scatter plot.

Value

three-dimensional plot. If type = "pca" returns three principal components scores - defaulted to the first three - against each other. If type = "cva" returns three-dimensional plot of residuals. If type = "lda" returns three-dimensional plot of three linear discriminant scores plotted against each other.

Examples

```
## Not run:
data(pendigits)
digits_features <- pendigits[, -35:-36]
threewise_plot(digits_features, digits_class, type = "pca", k = 0.0001)

library(dplyr)
data(COMBO17)
galaxy <- as_data_frame(COMBO17)
galaxy <- select(galaxy, -starts_with("e."), -Nr, -UFS:-IFD)
galaxy <- na.omit(galaxy)
galaxy_x <- select(galaxy, -Rmag:-chi2red)
galaxy_y <- select(galaxy, Rmag:chi2red)
threewise_plot(galaxy_x, galaxy_y, type = "cva")

data(iris)
iris_x <- iris[,1:4]
iris_y <- iris[5]
```

```
threewise_plot(iris_x, iris_y, type = "lda")

## End(Not run)
```

`tobacco` *MMST TOBACCO DATA*

Description

chemical composition of tobacco, 183, 187

Usage

```
tobacco
```

Format

a data frame with 25 observations on the following 9 variables.

- 'Y1.BurnRate' a numeric vector
- 'Y2.PercentSugar' a numeric vector
- 'Y3.PercentNicotine' a numeric vector
- 'X1.PercentNitrogen' a numeric vector
- 'X2.PercentChlorine' a numeric vector
- 'X3.PercentPotassium' a numeric vector
- 'X4.PercentPhosphorus' a numeric vector
- 'X5.PercentCalcium' a numeric vector
- 'X6.PercentMagnesium' a numeric vector

References

A. Izenman (2008). *Modern Multivariate Statistical Techniques*. Springer.

Anderson, R.L. and Bancroft, T.A. (1952). *Statistical Theory in Research*. New York: Mcgraw-Hill.

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