

Package ‘moveEZ’

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Title Animated Biplots

Version 1.3.0

Description Create animated biplots that enables dynamic visualisation of temporal or sequential changes in multivariate data by animating a single biplot across the levels of a time variable. It builds on objects from the 'biplotEZ' package, Lubbe S, le Roux N, Nienkemper-Swanepoel J, Ganey R, Buys R, Adams Z, Manefeldt P (2024) <[doi:10.32614/CRAN.package.biplotEZ](https://doi.org/10.32614/CRAN.package.biplotEZ)>, allowing users to create animated biplots that reveal how both samples and variables evolve over time.

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Encoding UTF-8

VignetteBuilder knitr

Depends R (>= 4.1.0)

Imports dplyr, biplotEZ, gganimate, ggplot2, GPAbin

Suggests testthat, rmarkdown, knitr, tibble, scales, RColorBrewer, purrr

Config/Needs/website rmarkdown

URL <https://muvisu.github.io/moveEZ/>

Config/roxygen2/version 8.0.0

NeedsCompilation no

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.calibrate.axis	<i>Calibrate axis</i>
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Description

Calibrate axis

Usage

```
.calibrate.axis(  
  j,  
  Xhat,  
  means,  
  sd,  
  axes.rows,  
  ax.which,  
  ax.tickvec,  
  ax.orthogxvec,  
  ax.orthogyvec  
)
```

Arguments

j	j
Xhat	Xhat
means	means
sd	sd
axes.rows	axes.rows
ax.which	ax.which
ax.tickvec	ax.tickvec
ax.orthogxvec	ax.orthogxvec
ax.orthogyvec	ax.orthogyvec

Value

Calibrated axes

Africa_climate	Climate studies example dataset
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Description

Data extracted from ERA5 hourly data on single levels from 1940 to present

Format

A dataset with 960 observations and 9 variables.

Details

Year 8 years from 1950 to 2020

Month 12 calendar months

Region 10 IPCC climate reference regions

AccPrec Accumulated precipitation

DailyEva Daily evaporation

Temp Mean temperature

SoilMois Soil moisture

SPI6 6-month standardised precipitation index

wind Windspeed

Source

DOI: 10.24381/cds.adbb2d47 (Accessed on 11-02-2025)

Africa_climate_target	Climate studies target example dataset
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Description

Data extracted from ERA5 hourly data on single levels for 1989

Format

A dataset with 120 observations and 9 variables.

Details

- Year** 8 years from 1950 to 2020
- Month** 12 calendar months
- Region** 10 IPCC climate reference regions
- AccPrec** Accumulated precipitation
- DailyEva** Daily evaporation
- Temp** Mean temperature
- SoilMois** Soil moisture
- SPI6** 6-month standardised precipitation index
- wind** Windspeed

Source

DOI: 10.24381/cds.adbb2d47 (Accessed on 11-02-2025)

axes_moveEZ	<i>Provide axes coordinates</i>
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Description

Provide axes coordinates

Usage

```
axes_moveEZ(bp, which.var)
```

Arguments

- bp Object
- which.var which variable(s) to find coordinates

Value

Axes coordinates

evaluation	<i>Measures of comparison for move plot 3</i>
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Description

This function calculates measures of comparison after generalised orthogonal Procrustes Analysis is performed in `moveplot3`. Orthogonal Procrustes Analysis is used to compare a target to a testee configuration. The following measures are calculate: Procrustes Statistic (PS), Congruence Coefficient (CC), Absolute Mean Bias (AMB), Mean Bias (MB) and Root Mean Squared Bias (RMSB).

Usage

```
evaluation(bp, centring = TRUE)
```

Arguments

<code>bp</code>	biplot object from <code>moveEZ</code>
<code>centring</code>	logical argument to apply centring or not (default is TRUE)

Value

<code>eval.tab</code>	Returns a table of the measures of comparison for each level of the time variable compared to the target.
<code>fit.plot</code>	Returns a line plot with the fit measures that are bounded between zero and one: PS and CC. A small PS value and large CC value indicate good fit.
<code>bias.plot</code>	Returns a line plot with bias measures that are unbounded: AMB, MB and RMSB. Small values indicate low bias.

Examples

```
data(Africa_climate)
data(Africa_climate_target)
bp <- biplotEZ::biplot(Africa_climate, scaled = TRUE) |> biplotEZ::PCA()
results <- bp |> moveplot3(time.var = "Year", group.var = "Region", hulls = TRUE,
move = FALSE, target = NULL) |> evaluation()
results$eval.tab
results$fit.plot
results$bias.plot

data(Africa_climate)
data(Africa_climate_target)
bp <- biplotEZ::biplot(Africa_climate, scaled = TRUE) |> biplotEZ::PCA()
results <- bp |> moveplot3(time.var = "Year", group.var = "Region", hulls = TRUE,
move = FALSE, target = Africa_climate_target) |> evaluation()
results$eval.tab
results$fit.plot
results$bias.plot
```

moveplot

Move plot

Description

Create animated biplot on samples in a biplot

Usage

```
moveplot(
  bp,
  time.var,
  group.var,
  move = TRUE,
  hulls = TRUE,
  scale.var = 5,
  shadow = FALSE,
  which = NULL,
  label.vars = NULL
)
```

Arguments

bp	biplot object from biplotEZ
time.var	time variable
group.var	group variable
move	whether to animate (TRUE) or facet (FALSE) samples, according to time.var
hulls	whether to display sample points or convex hulls
scale.var	scaling the vectors representing the variables
shadow	whether the animation will keep past states (only when hulls = FALSE)
which	integer index into the levels of group.var selecting which groups to display. Default (NULL) shows all groups.
label.vars	character vector of column name(s) used to label sample points, pasted together when more than one is supplied. Default (NULL) omits point labels.

Value

bp	Returns the elements of the biplot object bp from biplotEZ.
plot	An animated or a facet of biplots based on the dynamic frame.

Examples

```

data(Africa_climate)
bp <- biplot(Africa_climate, scaled = TRUE) |> PCA()

# Convex hulls facet plot
bp |> moveplot(time.var = "Year", group.var = "Region", hulls = TRUE, move = FALSE)

# Samples facet plot
bp |> moveplot(time.var = "Year", group.var = "Region", hulls = FALSE, move = FALSE)

# Specifying colours with colour palette in biplotEZ
bp <- biplot(Africa_climate, scaled = TRUE, group.aes = Africa_climate$Region) |>
PCA() |> samples(col = RColorBrewer::brewer.pal(10, "Paired"))
bp |> moveplot(time.var = "Year", group.var = "Region", hulls = TRUE, move = FALSE)

# Specifying plotting characters for grouping variable in biplotEZ
bp <- biplot(Africa_climate, scaled = TRUE, group.aes = Africa_climate$Region) |>
PCA() |> samples(pch = c(19, 21, 3))
bp |> moveplot(time.var = "Year", group.var = "Region", hulls = FALSE, move = FALSE)

# Specifying opacity of plotting characters and size of variable labels
bp <- biplot(Africa_climate, scaled = TRUE, group.aes = Africa_climate$Region) |>
PCA() |> samples(opacity = 0.4) |> axes(label.cex = 1.2)
bp |> moveplot(time.var = "Year", group.var = "Region", hulls = FALSE, move = FALSE)

# Specifying colours manually in biplotEZ
bp <- biplot(Africa_climate, scaled = TRUE, group.aes = Africa_climate$Region) |>
PCA() |> samples(col = c("firebrick4", "indianred3", "tomato", "sandybrown",
  "khaki1", "palegreen1", "darkseagreen2", "mediumaquamarine", "deepskyblue4", "mediumpurple4"))
bp |> moveplot(time.var = "Year", group.var = "Region", hulls = TRUE, move = FALSE)

# Extracting measures of fit of PCA
bp <- biplot(Africa_climate, scaled = TRUE) |> PCA() |> fit.measures()
bp <- bp |> moveplot(time.var = "Year", group.var = "Region", hulls = TRUE, move = FALSE)
bp$quality
bp$axis.predictivity

# Convex hulls move plot

if(interactive()) {
  bp |> moveplot(time.var = "Year", group.var = "Region", hulls = TRUE, move = TRUE)}

# Samples move plot with shadows

if(interactive()) {
  bp |> moveplot(time.var = "Year", group.var = "Region", hulls = FALSE, move = TRUE, shadow = TRUE)}

# CVA biplot
bp <- biplot(Africa_climate, scaled = TRUE) |> CVA(class = Africa_climate$Region)
bp <- bp |> moveplot2(group.var = "Region", time.var = "Year", move = FALSE)

# Extracting measures of fit of CVA

```

```
bp <- biplot(Africa_climate, scaled = TRUE) |>
  CVA(classes = Africa_climate$Region) |> fit.measures()
bp <- bp |> moveplot(time.var = "Year", group.var = "Region", hulls = TRUE, move = FALSE)
bp$quality
bp$axis.predictivity
bp$within.class.axis.predictivity
bp$within.class.sample.predictivity
```

moveplot2

Move plot 2

Description

Create animated biplot on samples and variables in a biplot

Usage

```
moveplot2(
  bp,
  time.var,
  group.var,
  move = TRUE,
  hulls = TRUE,
  scale.var = 5,
  align.time = NA,
  reflect = NA
)
```

Arguments

bp	biplot object from biplotEZ
time.var	time variable
group.var	group variable
move	whether to animate (TRUE) or facet (FALSE) samples and variables, according to time.var
hulls	whether to display sample points or convex hulls
scale.var	scaling the vectors representing the variables
align.time	a vector specifying the levels of time.var for which the biplots should be aligned. Only biplots corresponding to these time points will be used to compute the alignment transformation.
reflect	a character vector specifying the axis of reflection to apply at each corresponding time point in align.time. One of FALSE (default), "x" for reflection about the x-axis, "y" for reflection about the y-axis and "xy" for reflection about both axes.

Value

bp	Returns the elements of the biplot object bp from biplotEZ.
plot	An animated or a facet of biplots based on the dynamic frame.

Examples

```
data(Africa_climate)
bp <- biplot(Africa_climate, scaled = TRUE) |> PCA()

if(interactive()) {
  bp <- bp |> moveplot2(time.var = "Year", group.var = "Region", hulls = TRUE, move = TRUE)}

# Extracting measures of fit for PCA
bp <- bp |> moveplot2(time.var = "Year", group.var = "Region", hulls = TRUE, move = FALSE)
bp$quality
bp$axis.predictivity

# Extracting measures of fit for CVA
bp <- biplot(Africa_climate) |> CVA(classes = Africa_climate$Region)
bp <- bp |> moveplot2(time.var = "Year", group.var = "Region", hulls = TRUE, move = FALSE)
bp$quality
bp$axis.predictivity
bp$within.class.axis.predictivity
bp$within.class.sample.predictivity
```

moveplot3

Move plot 3

Description

Create animated biplot on samples and variables in a biplot with a given target

Usage

```
moveplot3(
  bp,
  time.var,
  group.var,
  move = TRUE,
  hulls = TRUE,
  scale.var = 5,
  target = NULL
)
```

Arguments

<code>bp</code>	biplot object from <code>biplotEZ</code>
<code>time.var</code>	time variable
<code>group.var</code>	group variable
<code>move</code>	whether to animate (TRUE) or facet (FALSE) samples and variables, according to <code>time.var</code>
<code>hulls</code>	whether to display sample points or convex hulls
<code>scale.var</code>	scaling the vectors representing the variables
<code>target</code>	Target data set to which all biplots should be matched consisting of the the same dimensions. If not specified, the centroid of all available biplot sample coordinates from <code>time.var</code> will be used. Default NULL.

Value

<code>bp</code>	Returns the elements of the biplot object <code>bp</code> from <code>biplotEZ</code> .
<code>iter_levels</code>	The levels of the time variable.
<code>coord_set</code>	The coordinates of the configurations before applying Generalised Orthogonal Procrustes Analysis.
<code>GPA_list</code>	The coordinates of the configurations after applying Generalised Orthogonal Procrustes Analysis.
<code>plot</code>	An animated or a facet of biplots based on the dynamic frame.

Examples

```
data(Africa_climate)
data(Africa_climate_target)
bp <- biplot(Africa_climate, scaled = TRUE) |> PCA()
bp |> moveplot3(time.var = "Year", group.var = "Region", hulls = TRUE,
move = FALSE, target = NULL)

if(interactive()) {
bp |> moveplot3(time.var = "Year", group.var = "Region", hulls = TRUE,
move = TRUE, target = NULL)}
bp |> moveplot3(time.var = "Year", group.var = "Region", hulls = TRUE,
move = FALSE, target = Africa_climate_target)
```

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