Package: GPAbin (via r-universe)

May 12, 2026

Title Unifying Multiple Biplot Visualisations into a Single Display

Version 1.1.1

Description Aligning multiple visualisations by utilising generalised orthogonal Procrustes analysis (GPA) before combining coordinates into a single biplot display as described in Nienkemper-Swanepoel, le Roux and Lubbe (2023)<doi:10.1080/03610918.2021.1914089>. This is mainly suitable to combine visualisations constructed from multiple imputations, however, it can be generalised to combine variations of visualisations from the same datasets (i.e. resamples).

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Depends R (>= 4.1.0)

Imports ca, jomo, mi, mice, missMDA, mitools, stringr

Suggests testthat, knitr

Config/Needs/website rmarkdown

BugReports https://github.com/jnienk/GPAbin/issues

URL https://jnienk.github.io/GPAbin/

Config/pak/sysreqs cmake make libicu-dev libuv1-dev libx11-dev zlib1g-dev

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Contents

`biplFig` *Biplot function*

Description

Creates a multiple correspondence analysis (MCA) biplot

Usage

```
biplFig(
  missbp,
  Z.col = "#61223b",
  CLP.col = "#b79962",
  Z.pch = 19,
  CLP.pch = 15,
  Z.cex = 1.5,
  CLP.cex = 1.7,
  title = ""
)
```

Arguments

`missbp`	An object of class `missbp` obtained from preceding function `missmi()`
`Z.col`	Colour of sample coordinates
`CLP.col`	Colour of category level point coordinates
`Z.pch`	Plotting character of sample coordinates
`CLP.pch`	Plotting character of category level point coordinates
`Z.cex`	Size of plotting character for sample points

CLP.cex	Size of plotting character for category level point points
title	Title of the plot

Value

- If compdat = NULL in evalMeas, only a GPAbin biplot will be constructed.
- If a complete data set (compdat) was specified in evalMeas, two biplots will be constructed: (1) Complete MCA biplot and (2) GPAbin biplot.

Examples

```
data(implist)
missbp <- missmi(implist)|> DRT() |> GPAbin() |> biplFig()
```

CLPpred *Category level prediction*

Description

Predicts category levels from an MCA based biplot using the distances between coordinates

Usage

```
CLPpred(CLPs = CLPs, Zs = Zs, p = p, n = n, lvls = lvls, datIN = datIN)
```

Arguments

CLPs	Category level point coordinates
Zs	Sample coordinates
p	Number of variables
n	Number of samples
lvls	Names of category levels
datIN	Input data from which CLPs and Zs are obtained

Value

predCL	Final predicted categorical data set

compdat *Complete data example*

Description

Simulated data example

Format

A data frame with 1000 rows and 5 columns.

Details

V1 Variable 1

V1 Variable 2

V1 Variable 3

V1 Variable 4

V1 Variable 5

Source

Simulated data from a uniform distribution that is categorised into levels.

DRT *Dimension reduction*

Description

Multiple correspondence analysis is performed on the multiple imputed datasets

Usage

```
DRT(missbp, method = c("MCA"))
```

Arguments

missbp	An object of class missbp obtained from preceding function missmi()
method	Select a dimension reduction technique. In the current version MCA is available.

Value

The missbp object is appended with the following objects:

Z	List of sample coordinates
CLP	List of category level point coordinates
lvls	List of category level names
m	Number of multiple imputations

See also missmi and impute.

Examples

```
data(implist)
missbp <- missmi(implist) |> DRT()
```

---

evalMeas *Evaluation measures when complete data is available*

Description

Calculates measures of comparison based on distances between two configurations in two dimensions.

Usage

```
evalMeas(missbp, compdat = NULL)
```

Arguments

missbp	An object of class missbp obtained from preceding function missmi().
compdat	Complete data matrix representing the input data of missmi()

Value

The missbp object is appended with the following objects:

eval	Returns a data table with five evaluation measures: Procrustes Statistic (PS), Similarity Proportion (SP), Response Profile Recovery (RPR), Absolute Mean Bias (AMB), Root Mean Squared Bias (RMSB)
GPApred	A dataframe representing predicted categorical responses from the GPAbin biplot.
compPred	A dataframe representing predicted categorical responses from the complete MCA biplot.
compZs	Sample coordinates for the MCA biplot of the complete data.
compCLPs	CLPs for the MCA biplot of the complete data.

complvls	Names of the CLPs for the MCA biplot of the complete data.

See also missmi, impute, DRT and GPAbin.

For more detail, refer to Nienkemper-Swanepoel, J., le Roux, N. J., & Gardner-Lubbe, S. (2021). GPAbin: unifying visualizations of multiple imputations for missing values. Communications in Statistics - Simulation and Computation, 52(6), 2666–2685. https://doi.org/10.1080/03610918.2021.1914089.

Examples

```
data(compdat)
data(implist)
missbp <- missmi(implist) |> DRT() |> GPAbin() |> evalMeas(compdat=compdat)
```

---

ggbiplFig *ggBiplot function*

Description

Creates a multiple correspondence analysis (MCA) biplot in ggplot.

Usage

```
ggbiplFig(
  missbp,
  Z.col = "#61223b",
  CLP.col = "#b79962",
  Z.pch = 19,
  CLP.pch = 15
)
```

Arguments

missbp	An object of class missbp obtained from preceding function missmi()
Z.col	Colour of sample coordinates
CLP.col	Colour of category level point coordinates
Z.pch	Plotting character of sample coordinates
CLP.pch	Plotting character of category level point coordinates

Value

- plotReturns a GPAbin ggplot biplot.
- plotCReturns an MCA ggplot biplot of the complete data set, if provided.

Examples

```
data(implist)
data(compdat)
missbp <- missmi(implist)|> DRT() |> GPAbin() |>
evalMeas(compdat = compdat) |> ggbiplFig()

### GPAbin biplot

missbp$plot

### MCA biplot

missbp$plotC
```

GPA *Generalised Orthogonal Procrustes Analysis*

Description

This function contains the OPA function to compare two configurations and the GPA function for multiple configuration comparisons

Usage

```
GPA(Xk, G.target = NULL, iter = 500, eps = 0.001)
```

Arguments

Xk	list containing the testee configurations which is updated on #each iteration
G.target	Target configuration. If not specified the centroid configuration will be used as the target
iter	Number of iterations allowed before convergence
eps	Threshold value for convergence of the alogrithm

Value

Xk.F	List containing the updated testee configurations
sk.F	Vector containing the final scaling factors
Qk.F	List containing the final rotation matrices
Gmat	Final target configuration
sum.sq	Final minimised sum of squared distance

GPAbin *Function to unify coordinates of multiple configurations*

Description

Combines multiple configurations from dimension reduction solutions applied to multiple imputed data sets

Usage

```
GPAbin(missbp, G.target = NULL)
```

Arguments

missbp	An object of class missmi obtained from preceding function missmi()
G.target	Target configuration. If not specified the centroid configuration will be used as the target.

Value

The missbp object is appended with the following objects:

Z.GPA.list	List containing the sample coordinates for each MI after GPA
CLP.GPA.list	List containing the CLPs for each MI after GPA
G.target	Target configuration
Z.GPAbin	Sample coordinates for the GPAbin biplot
CLP.GPAbin	CLPs for the GPAbin biplot

See also missmi, impute and DRT.

For more detail, refer to Nienkemper-Swanepoel, J., le Roux, N. J., & Gardner-Lubbe, S. (2021). GPAbin: unifying visualizations of multiple imputations for missing values. Communications in Statistics - Simulation and Computation, 52(6), 2666–2685. https://doi.org/10.1080/03610918.2021.1914089.

Examples

```
data(implist)
missbp <- missmi(implist) |> DRT() |> GPAbin()
```

implist *List of multiple imputed data sets*

Description

Five multiple imputations of `missdat`

Format

List containing five multiple imputations of `missdat`. Each list item a data frame with 1000 rows and 5 columns.

Details

V1 Variable 1

V1 Variable 2

V1 Variable 3

V1 Variable 4

V1 Variable 5

Source

simulated example data imputed with mice::mice(missdat, m=5, method="polyreg", maxit=10, remove.collinear=FALSE, printFlag = FALSE)

impute *Multiple imputation*

Description

Choose between four available multiple imputation strategies in `R`.

Usage

```
impute(missbp, imp.method = c("MIMCA", "jomo", "DPMPM", "mice"), m = 5)
```

Arguments

`missbp`	An object of class `missmi` obtained from preceding function `missmi()`.
`imp.method`	Select one of four imputation methods: `MIMCA`, `jomo`, `DPMPM`, `mice`
`m`	Number of multiple imputations

Value

The missbp object is appended with the following object:

dataimp List of imputed data

See also MIMCA, jomo1cat, mi and mice.

Examples

```
data(missdat)
missbp <- missmi(missdat) |> impute(imp.method="DPMPM", m=5)
```

---

missdat *Missing data example*

Description

compdat containing approximately 35% simulated missing values according to a missing at random (MAR) missing data mechanism

Format

A data frame with 1000 rows and 5 columns.

Details

V1 Variable 1

V1 Variable 2

V1 Variable 3

V1 Variable 4

V1 Variable 5

Source

Simulated data from a uniform distribution that is categorised into levels.

missmi *First step before constructing unified biplots*

Description

This function produces a list of elements to be used when producing a GPAbin biplot.

Usage

```
missmi(data)
```

Arguments

data	input data frame or list

Value

X	The processed data
m	Number of multiple imputations applied
n	The number of samples
p	The number of variables
miss_pct	Percentage of missing values

Examples

```
data(missdat)
missbp <- missmi(missdat)
data(implist)
missbp <- missmi(implist)
```

OPA *Orthogonal Procrustes Analysis*

Description

This function performs Orthogonal Procrustes Analysis on centred data

Usage

```
OPA(missbp, compdat, centring = TRUE, dim = "2D")
```

Arguments

missbp	An object of class missmi obtained from preceding function missmi()
compdat	Complete data set, only available for simulated data examples.
centring	Logical argument to apply centering, default is TRUE.
dim	Number of dimensions to use in final solutions (2D or All available dimensions.)

Value

ProcStat	Procrustes Statistic
compZ	Sample coordinates representing the complete data set
compCLP	Category level point coordinates representing the complete data set
complvls	Category levels
compdat	Complete data set, only available for simulated data examples

---

print.missmi *Generic print function for objects of class missmi*

Description

This function is used to print output when the missmi biplot object is created.

Usage

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

Arguments

x	an object of class missmi.
...	additional arguments.

Value

This function will not produce a return value, it is called for side effects.

Examples

```
data(missdat)
missbp <- missmi(missdat)
data(implist)
missbp <- missmi(implist)
print(missbp)
```

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