Package 'andrews'

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Type Package

Title Various Andrews Curves

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Depends R (>= 2.10)

Description Visualisation of multidimensional data through different Andrews curves: Andrews, D. F. (1972) Plots of High-Dimensional Data. Biometrics, 28(1), 125-136. <doi:10.2307/2528964>.

License GPL-3

URL https://github.com/sigbertklinke/andrews (development version)

Encoding UTF-8

LazyData true

Imports grDevices, graphics, gmp

Suggests knitr, rmarkdown, robustbase, mclust

VignetteBuilder knitr

RoxygenNote 7.2.3

NeedsCompilation no

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`andrews` *Andrews curves*

Description

Andrews curves for visualization of multidimensional data. For colouring the curves see the details. For differences between `andrews` and `andrews0` see the `vignette("andrews")`. With the same parameters called both functions should create the same plot. `type==5` is a modification of `type==3` and `type==6` is a modification of `type==4`.

Usage

```
andrews(
  df,
  type = 1,
  clr = NULL,
  step = 100,
  ymax = 10,
  alpha = NULL,
  palcol = NULL,
  lwd = 1,
  lty = "solid",
  ...
)
```

Arguments

`df`	data frame or an R object that can be converted into a data frame with `as.data.frame`
`type`	type of curve • 1: $f(t) = x_1/\sqrt{2} + x_2\sin(t) + x_3\cos(t) + x_4\sin(2t) + x_5\cos(2t) + ...$ • 2: $f(t) = x_1\sin(t) + x_2\cos(t) + x_3\sin(2t) + x_4\cos(2t) + ...$ • 3: $f(t) = x_1\cos(t) + x_2\cos(\sqrt{2}t) + x_3\cos(\sqrt{3}t) + ...$ • 4: $f(t) = 0.5^{p/2}x_1 + 0.5^{(p-1)/2}x_2(\sin(t)+\cos(t)) + 0.5^{(p-2)/2}x_3(\sin(t)-\cos(t)) + 0.5^{(p-3)/2}x_4(\sin(2t)+\cos(2t)) + 0.5^{(p-4)/2}x_5(\sin(2t)-\cos(2t)) + ...)$ with p the number of variables • 5: $f(t) = x_1\cos(\sqrt{p_0}t) + x_2\cos(\sqrt{p_1}t) + x_3\cos(\sqrt{p_2}t) + ...$ with $p_0 = 1$ and p_i the i-th prime number • 6: $f(t) = 1/\sqrt{2}(x_1 + x_2(\sin(t)+\cos(t)) + x_3(\sin(t)-\cos(t)) + x_4(\sin(2t)+\cos(2t)) + x_5(\sin(2t)-\cos(2t)) + ...)$
`clr`	number/name of column in the data frame for color of curves

step	smoothness of curves
ymax	maximum of y coordinate
alpha	semi-transparent color ($0 < alpha < 1$) which are supported only on some devices
palcol	a function which generates a set of colors, see details
lwd	line width, a positive number, defaulting to 1.
lty	line type, can either be specified as an integer (0=blank, 1=solid (default), 2=dashed, 3=dotted, 4=dotdash, 5=longdash, 6=twodash) or as one of the character strings "blank", "solid", "dashed", "dotted", "dotdash", "longdash", or "twodash", where "blank" uses 'invisible lines' (i.e., does not draw them).
...	further named parameters given to graphics::plot.default() except x, y, and type.

Details

If clr has length one then it is used as column number or column name for coloring the curves:

- If df[,clr] is numeric then palcol must be function which returns colors for values in the range \[0, 1\] using normalized variable. The default is function function(v) { hsv(0,1,v) }.
- Otherwise df[,clr] is converted to a factor and palcol must be a function which returns for each level a color. The parameter for palcol is the numbe of levels and the default is grDevices::rainbow(). If the length of clr is the number of rows of df then clr is interpreted as colors.

Andrews curves transform multidimensional data into curves. This package presents four types of curves.

Value

nothing

Author(s)

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References

- Andrews, D. F. (1972) Plots of High-Dimensional Data. Biometrics, vol. 28, no. 1, pp. 125-136.
- Khattree, R., Naik, D. N. (2002) Andrews Plots for Multivariate Data: Some New Suggestions and Applications. Journal of Statistical Planning and Inference, vol. 100, no. 2, pp. 411-425.

Examples

```
data(iris)
op <- par(mfrow=c(1,2))
andrews0(iris,clr=5,ymax=3)
andrews(iris,clr=5,ymax=3)
par(op)
andrews(iris,type=4,clr=5,ymax=NA)
```

`andrews0` *Andrews curves*

Description

Andrews curves for visualization of multidimensional data. For differences between `andrews` and `andrews2` see the 'vignette("andrews"). For colouring the curves see the details.

Usage

```
andrews0(
  df,
  type = 1,
  clr = NULL,
  step = 100,
  ymax = 10,
  main = NULL,
  sub = NULL
)
```

Arguments

`df`	data frame
`type`	type of curve • 1: $f(t) = x_1/\sqrt{2} + x_2\sin(t) + x_3\cos(t) + x_4\sin(2t) + x_5\cos(2t) + ...$ • 2: $f(t) = x_1\sin(t) + x_2\cos(t) + x_3\sin(2t) + x_4\cos(2t) + ...$ • 3: $f(t) = 0.5^{p/2}x_1 + 0.5^{(p-1)/2}x_2(\sin(t)+\cos(t)) + 0.5^{(p-2)/2}x_3(\sin(t)-\cos(t)) + 0.5^{(p-3)/2}x_4(\sin(2t)+\cos(2t)) + 0.5^{(p-6)/2}x_5(\sin(2t)-\cos(2t)) + ...)$ with p the number of variables • 4: $f(t) = 1/\sqrt{2}(x_1 + x_2(\sin(t)+\cos(t)) + x_3(\sin(t)-\cos(t)) + x_4(\sin(2t)+\cos(2t)) + x_5(\sin(2t) - \cos(2t)) + ...)$
`clr`	number/name of column in the date frame for color of curves
`step`	smoothness of curves
`ymax`	maximum of y coordinate.
`main`	main title for the plot
`sub`	sub title for the plot

Details

Andrews curves transform multidimensional data into curves. This package presents four types of curves

If `df[,clr]` is numeric then `hsv(1,1,v)` with the normalized values (on `\[0, 1\]`) of `df[,clr]` is used. Otherwise the number of unique values in `nuv <- unique(df[,clr])` is used in connection with `rainbow(nuv)`.

Value

nothing

Author(s)

Jaroslav Myslivec jaroslav.myslivec@upce.cz

References

- Andrews, D. F. (1972) Plots of High-Dimensional Data. Biometrics, vol. 28, no. 1, pp. 125-136.
- Khattree, R., Naik, D. N. (2002) Andrews Plots for Multivariate Data: Some New Suggestions and Applications. Journal of Statistical Planning and Inference, vol. 100, no. 2, pp. 411-425.

Examples

```
data(iris)
andrews0(iris,clr=5,ymax=3)
andrews0(iris,type=4,clr=5,ymax=2)
```

---

banknote *Swiss banknotes data*

Description

The data set contains six measurements made on 100 genuine and 100 counterfeit old-Swiss 1000-franc bank notes. The data frame and the documentation is a copy of mclust::banknote.

Usage

```
banknote
```

Format

A data frame with 200 rows and 7 columns:

Status the status of the banknote: `genuine` or `counterfeit`

Length Length of bill (mm)

Left Width of left edge (mm)

Right Width of right edge (mm)

Bottom Bottom margin width (mm)

Top Top margin width (mm)

Diagonal Length of diagonal (mm)

Source

Flury, B. and Riedwyl, H. (1988). Multivariate Statistics: A practical approach. London: Chapman & Hall, Tables 1.1 and 1.2, pp. 5-8.

`deftype` *deftype*

Description

Defines a function which can be used as basis for Andrews curves $f_t(t) = \sum_{j=1}^{p} x_{ij} f_i(t)$.

Usage

```
deftype(index = NULL, FUN = NULL, xlim = c(-pi, pi))
```

Arguments

`index`	index/name of the function
`FUN`	function of the form `function(n, t) {...}`
`xlim`	default range for displaying curves (default: `c(-pi,pi)`)

Value

either a list of all functions or a single function

Examples

```
# define a new andrews curve, just with sine curves
deftype("sine", function(n, t) {
          n <- as.integer(if (n<1) 1 else n)
          m <- matrix(NA, nrow=length(t), ncol=n)
          for (i in 1:n) m[,i] <- sin(i*t)
          m
         })
andrews(iris, "sine")
# query
deftype()
deftype("sine")
```

generate_n_primes *Generate a Sequence of Prime Numbers*

Description

Generates a vector of the first n primes using `gmp::nextprime()`.

Usage

```
generate_n_primes(n, one = FALSE)
```

Arguments

n	the number of primes to generate.
one	should 1 included in the sequence (default: FALSE)

Value

an integer vector of prime numbers

Examples

```
generate_n_primes(5)
generate_n_primes(5, TRUE)
```

normalize *Normalization*

Description

Normalization of a variable:

- type==1: ar normalized into $[0, 1]$,
- type==2: ar is standardized,
- otherwise no normalization is done.

Usage

```
normalize(ar, type = 1)
```

Arguments

ar	numeric variable.
type	integer: type of normalization (default: 1)

Details

Normalization of variable: `ar<-(ar-min(ar))/(max(ar)-min(ar))`

Value

Returns normalized variable.

Author(s)

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Examples

```
normalize(iris[,1])
```

---

numarray *Numeric array*

Description

Extracts numeric array from data frame.

Usage

```
numarray(df)
```

Arguments

`df`	data frame.

Details

Extracts numeric array from data frame.

Value

Returns numeric array.

Author(s)

Jaroslav Myslivec jaroslav.myslivec@upce.cz, Sigbert Klinke sigbert@hu-berlin.de

Examples

```
numarray(iris)
```

outlyingness *outlyingness*

Description

Computes the Stahel-Donoho outlyingness. If type is any of the available types by andrews() then the projection vectors are generated along the andrews curves. Otherwise step random directions will be used. Note that the projection vectors are always normalized to length one.

Usage

```
outlyingness(x, type = 1, step = 100, xlim = NULL, normalize = 1)
```

Arguments

x	data frame
type	type of curve, see andrews()
step	step smoothness of curves
xlim	the x limits (x1, x2)
normalize	type of normalization, see normalize()

Value

the Stahel-Donoho outlyingness

References

- Stahel, W. (1981), Robuste Schätzungen: infinitesimale Optimalität und Schätzungen von Kovarianzmatrizen, PhD thesis, ETH Z¨urich.
- Donoho, D. (1982), Breakdown properties of multivariate location estimators, Ph.D. Qualifying paper, Dept. Statistics, Harvard University, Boston.

Examples

```
# use projection vectors from the Andrews curve
sdo <- outlyingness(iris)
col <- gray(1-sdo/max(sdo))
andrews(iris, clr=col, ymax=NA)
# use 1000 random projection vectors
sdo <- outlyingness(iris, type=0, step=1000)
col <- gray(1-sdo/max(sdo))
andrews(iris, clr=col, ymax=NA)
# use 1000 random projection vectors with adjusted outlyingness
library("robustbase")
x   <- numarray(iris)
x   <- scale(x, center=apply(x, 2, min), scale=apply(x, 2, max)-apply(x, 2, min))
sdo <- adjOutlyingness(x, ndir=1000, only.outlyingness=TRUE)
```

```
col <- gray(1-sdo/max(sdo))
andrews(as.data.frame(x), clr=col, ymax=NA)
```

`selectand` *Selecting in Andrews curves*

Description

Selecting object utility in Andrews curves

Usage

```
selectand(df, type = 1, step = 100, ncol = 0, from = 0, to = 1, col = 2)
```

Arguments

`df`	data frame.
`type`	type of curve.
`step`	smoothness of curves.
`ncol`	number of column in data frame for selection.
`from`	from value.
`to`	to value.
`col`	color of selected objects.

Details

Define which objects will be selected (colored) in Andrews curves.

Value

Nothing

Author(s)

Jaroslav Myslivec jaroslav.myslivec@upce.cz

Examples

```
data(iris)
andrews(iris,clr=5,ymax=3)
selectand(iris,ncol=1,from=5,to=5.5,col=1)
```

zzz *Comparison*

Description

Creates and displays a temporary PDF file with different diagrams comparing `andrews` and `andrews0` plots.

Usage

```
zzz()
```

Value

nothing

Examples

```
if (interactive()) zzz()
```

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