Package 'BasketballAnalyzeR'

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Type Package

Title Analysis and Visualization of Basketball Data

Version 0.8.1

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Description Contains data and code to accompany the book P. Zuccolotto and M. Manisera (2020) Basketball Data Science. Applications with R. CRC Press. ISBN 9781138600799.

License GPL (>= 2.0)

Encoding UTF-8

LazyData true

URL https://github.com/sndmrc/BasketballAnalyzeR/

BugReports https://github.com/sndmrc/BasketballAnalyzeR/issues

Contact <basketballanalyzer.help@unibs.it>

Depends R (>= 3.4), ggplot2 (>= 3.4.0)

Imports plyr (>= 1.8.4), dplyr (>= 0.7.6), tidyr (>= 0.8.1), rlang (>= 0.4.3), magrittr (>= 1.5), ggrepel (>= 0.8), gridExtra (>= 2.3), MASS (>= 7.3), directlabels (>= 2018.05), corrplot (>= 0.80), PBSmapping (>= 2.70), sp (>= 1.3), operators (>= 0.1), stringr (>= 1.3), GGally (>= 1.4), statnet.common (>= 4.2), readr (>= 1.3), utils (>= 4.2.3), gtools (>= 3.9.4), data.table (>= 1.14), mathjaxr (>= 1.6), stats, grDevices, graphics

Suggests dendextend (>= 1.8), ggnetwork (>= 0.5), ggplotify (>= 0.0.3), network (>= 1.13.0)

RdMacros mathjaxr

RoxygenNote 7.3.3

NeedsCompilation no

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Contents

`assistnet` *Investigates the network of assists-shots in a team*

Description

The `assistnet` command provides a comprehensive analysis of a team's assist-shot network, revealing crucial insights into player interactions and on-court dynamics.

Usage

```
assistnet(
  data,
  assist = "assist",
  player = "player",
  points = "points",
  event.type = "event_type",
  normalize = FALSE,
  period.length = 12,
  time.thr = 0
)
```

Arguments

`data`	a data frame whose rows are field shots and columns are variables to be specified in `assist`, `player`, `points`, `event.type` (see Details).
`assist`	character, indicating the name of the variable with players who made the assists, if any.
`player`	character, indicating the name of the variable with players who made the shot.
`points`	character, indicating the name of the variable with points.
`event.type`	character, indicating the name of the variable with type of event (mandatory categories are `"miss"` for missed field shots and `"shot"` for field goals).
`normalize`	logical, if `TRUE` the number of assists is normalized (default `normalize=FALSE`, see Details).
`period.length`	numerical, the length of a quarter in minutes (default: 12 minutes as in NBA)
`time.thr`	numerical, Minimum number of minutes played together by a pair of players required for computing their normalized assist count. Pairs below `time.thr` are excluded to avoid inflation due to small denominators (default: `time.thr = 0`).

Details

The data data frame could also be a play-by-play dataset provided that rows corresponding to events different from field shots are not coded as "shot" in the event.type variable. (To be completed)

Normalization:

$$4 \cdot (\text{period.length}) \cdot \frac{(\text{number of assists})}{(\text{minutes played in attack by each couple of players})}$$

Value

A list with 3 elements, assistTable (a table), nodeStats (a data frame), and assistNet (a network object). See Details.

assistTable, the cross-table of assists made and received by the players.

nodeStats, a data frame with the following variables:

- FGM (fields goals made),
- FGM_AST (field goals made thanks to a teammate's assist),
- FGM_ASTp (percentage of FGM_AST over FGM),
- FGPTS (points scored with field goals),
- FGPTS_AST (points scored thanks to a teammate's assist),
- FGPTS_ASTp (percentage of FGPTS_AST over FGPTS),
- AST (assists made),
- ASTPTS (point scored by assist's teammates).

minTable, a square matrix with the total number of minutes played in attack by each pair of players; the elements on the principal diagonal are set to zero.

assistminTable, a matrix showing the assist frequency between player pairs, adjusted for minutes played together in attack and expressed per 4*period.length minutes.

assistNet, an object of class network that can be used for further network analysis with specific R packages (see network)

Author(s)

Marco Sandri, Paola Zuccolotto, Marica Manisera (<basketballanalyzer.help@unibs.it>)

References

P. Zuccolotto and M. Manisera (2020) Basketball Data Science: With Applications in R. CRC Press.

P. Zuccolotto, M. Manisera and M. Sandri (2026) Advanced Basketball Data Science: With Applications in R. CRC Press.

Examples

```
PbP <- PbPmanipulation(PbP.BDB)
PbP.GSW <- subset(PbP, team=="GSW")
out <- assistnet(PbP.GSW)
plot(out)
## Not run:
  out <- assistnet(PbP.GSW, normalize=TRUE, time.thr=50)
  plot(out, edge.thr=5)

## End(Not run)
```

`barline` *Draws a bar-line plot*

Description

Draws a bar-line plot

Usage

```
barline(
  data,
  id,
  bars,
  line,
  order.by = id,
  decreasing = TRUE,
  labels.bars = NULL,
  label.line = NULL,
  position.bars = "stack",
  title = NULL
)
```

Arguments

`data`	a data frame.
`id`	character, name of the ID variable.
`bars`	character vector, names of the bar variables.
`line`	character, name of the line variable.
`order.by`	character, name of the variable used to order bars (on the x-axis).
`decreasing`	logical; if `TRUE`, decreasing order.
`labels.bars`	character vector, labels for the bar variables.
`label.line`	character, label for the line variable on the second y-axis (on the right).
`position.bars`	character, used to adjust the positioning of the bars in the plot; there are four main options: `stack`, `fill`, `dodge`, and `identity`.
`title`	character, plot title.

Value

A ggplot2 object

Author(s)

Marco Sandri, Paola Zuccolotto, Marica Manisera (< basketballanalyzer.help@unibs.it>)

References

P. Zuccolotto and M. Manisera (2020) Basketball Data Science: With Applications in R. CRC Press.

Examples

```
dts <- subset(Pbox, Team=="Houston Rockets" & MIN>=500)
barline(data=dts, id="Player", bars=c("P2p","P3p","FTp"),
        line="MIN", order.by="Player",
        labels.bars=c("2P","3P","FT"), title="Houston Rockets")
```

---

bubbleplot *Draws a bubble plot*

Description

Draws a bubble plot

Usage

```
bubbleplot(
  data,
  id,
  x,
  y,
  col,
  size,
  text.col = NULL,
  text.size = 2.5,
  scale.size = TRUE,
  labels = NULL,
  mx = NULL,
  my = NULL,
  mcol = NULL,
  title = NULL,
  repel = TRUE,
  text.legend = TRUE,
  hline = TRUE,
  vline = TRUE
)
```

Arguments

data	a data frame.
id	character, name of the ID variable.
x	character, name of the x-axis variable.
y	character, name of the y-axis variable.
col	character, name of variable on the color axis.
size	character, name of variable on the size axis.
text.col	character, name of variable for text colors.
text.size	numeric, text font size (default 2.5).
scale.size	logical; if TRUE, size variable is rescaled between 0 and 100.
labels	character vector, variable labels (on legend and axis).
mx	numeric, x-coordinate of the vertical axis; default is the mean value of x variable.
my	numeric, y-coordinate of the horizontal axis; default is the mean value of y variable.
mcol	numeric, midpoint of the diverging scale (see scale_colour_gradient2); default is the mean value of col variable.
title	character, plot title.
repel	logical; if TRUE, activate text repelling.
text.legend	logical; if TRUE, show the legend for text color.
hline	logical; if TRUE, a horizontal line is drawn with y intercept at the mean value of the variable on the y axis.
vline	logical; if TRUE, a vertical line is drawn with x intercept at the mean value of the variable on the x axis.

Value

A ggplot2 object

Author(s)

Marco Sandri, Paola Zuccolotto, Marica Manisera (<basketballanalyzer.help@unibs.it>)

References

P. Zuccolotto and M. Manisera (2020) Basketball Data Science: With Applications in R. CRC Press.

Examples

```
X <- with(Tbox, data.frame(T=Team, P2p=P2p, P3p=P3p, FTp=FTp, AS=P2A+P3A+FTA))
labs <- c("2-point shots (% made)","3-point shots (% made)",
          "free throws (% made)","Total shots attempted")
bubbleplot(X, id="T", x="P2p", y="P3p", col="FTp",
           size="AS", labels=labs)
```

`corranalysis` *Correlation analysis*

Description

Correlation analysis

Usage

```
corranalysis(data, threshold = 0, sig.level = 0.95)
```

Arguments

`data`	a numeric matrix or data frame (see `cor`).
`threshold`	numeric, correlation cutoff (default 0); correlations in absolute value below `threshold` are set to 0.
`sig.level`	numeric, significance level (default 0.95); correlations with p-values greater that `1-sig.level` are set to 0.

Value

A list with the following elements:

- `corr.mtx` (the complete correlation matrix)
- `corr.mtx.trunc` (the truncated correlation matrix)
- `cor.mtest` (the output of the significance test on correlations; see `cor.mtest`)
- `threshold` correlation cutoff
- `sig.level` significance level

Author(s)

Marco Sandri, Paola Zuccolotto, Marica Manisera (<basketballanalyzer.help@unibs.it>)

References

P. Zuccolotto and M. Manisera (2020) Basketball Data Science: With Applications in R. CRC Press.

See Also

`plot.corranalysis`.

Examples

```
data <- data.frame(Pbox$PTS,Pbox$P3M,Pbox$P2M,
                   Pbox$OREB + Pbox$DREB,Pbox$AST,
                   Pbox$TOV,Pbox$STL,Pbox$BLK)/Pbox$MIN
names(data) <- c("PTS","P3M","P2M","REB","AST","TOV","STL","BLK")
data <- subset(data, Pbox$MIN >= 500)
out <- corranalysis(data, threshold = 0.5)
```

`CreateRadialPlot` *R function CreateRadialPlot by William D. Vickers, freely downloadable from the web*

Description

R function CreateRadialPlot by William D. Vickers, freely downloadable from the web

Usage

```
CreateRadialPlot(
  plot.data,
  axis.labels = colnames(plot.data)[-1],
  grid.min = -0.5,
  grid.mid = 0,
  grid.max = 0.5,
  centre.y = grid.min - ((1/9) * (grid.max - grid.min)),
  plot.extent.x.sf = 1.2,
  plot.extent.y.sf = 1.2,
  x.centre.range = 0.02 * (grid.max - centre.y),
  label.centre.y = FALSE,
  grid.line.width = 0.5,
  gridline.min.linetype = "longdash",
  gridline.mid.linetype = "longdash",
  gridline.max.linetype = "longdash",
  gridline.min.colour = "grey",
  gridline.mid.colour = "blue",
  gridline.max.colour = "grey",
  grid.label.size = 4,
  gridline.label.offset = -0.02 * (grid.max - centre.y),
  label.gridline.min = TRUE,
  axis.label.offset = 1.15,
  axis.label.size = 2.5,
  axis.line.colour = "grey",
  group.line.width = 1,
  group.point.size = 4,
  background.circle.colour = "yellow",
  background.circle.transparency = 0.2,
  plot.legend = if (nrow(plot.data) > 1) TRUE else FALSE,
```

```
  legend.title = "Player",
  legend.text.size = grid.label.size,
  titolo = FALSE
)
```

Arguments

plot.data	plot.data
axis.labels	axis.labels
grid.min	grid.min
grid.mid	grid.mid
grid.max	grid.max
centre.y	centre.y
plot.extent.x.sf	plot.extent.x.sf
plot.extent.y.sf	plot.extent.y.sf
x.centre.range	x.centre.range
label.centre.y	label.centre.y
grid.line.width	grid.line.width
gridline.min.linetype	gridline.min.linetype
gridline.mid.linetype	gridline.mid.linetype
gridline.max.linetype	gridline.max.linetype
gridline.min.colour	gridline.min.colour
gridline.mid.colour	gridline.mid.colour
gridline.max.colour	gridline.max.colour
grid.label.size	grid.label.size
gridline.label.offset	gridline.label.offset
label.gridline.min	label.gridline.min
axis.label.offset	axis.label.offset
axis.label.size	axis.label.size

`axis.line.colour`
: axis.line.colour

`group.line.width`
: group.line.width

`group.point.size`
: group.point.size

`background.circle.colour`
: background.circle.colour

`background.circle.transparency`
: background.circle.transparency

`plot.legend`
: plot.legend

`legend.title`
: legend.title

`legend.text.size`
: legend.text.size

`titolo`
: plot title

Details

A description of the function can be found at the following link: http://rstudio-pubs-static.s3.amazonaws.com/5795_e6e6411731bb4f1b9cc7eb49499c2082.html

References

Vickers D.W. (2006) Multi-Level Integrated Classifications Based on the 2001 Census, PhD Thesis, School of Geography, The University of Leeds

---

`densityplot` *Computes and plots kernel density estimation of shots with respect to a concurrent variable*

Description

Computes and plots kernel density estimation of shots with respect to a concurrent variable

Usage

```
densityplot(
  data,
  var,
  shot.type = "field",
  thresholds = NULL,
  best.scorer = FALSE,
  period.length = 12,
  bw = NULL,
  title = NULL
)
```

Arguments

data	a data frame whose rows are shots and with the following columns: ShotType, player, points and at least one of playlength, periodTime, totalTime, shot_distance (the column specified in var, see Details).
var	character, a string giving the name of the numerical variable according to which the shot density is estimated. Available options: "playlength", "periodTime", "totalTime", "shot_distance".
shot.type	character, a string giving the type of shots to be analyzed. Available options: "2P", "3P", "FT", "field".
thresholds	numerical vector with two thresholds defining the range boundaries that divide the area under the density curve into three regions. If NULL default values are used.
best.scorer	logical; if TRUE, displays the player who scored the highest number of points in the corresponding interval.
period.length	numeric, the length of a quarter in minutes (default: 12 minutes as in NBA).
bw	numeric, the value for the smoothing bandwidth of the kernel density estimator or a character string giving a rule to choose the bandwidth (see density).
title	character, plot title.

Details

The data data frame could also be a play-by-play dataset provided that rows corresponding to events different from shots have NA in the ShotType variable.

Required columns:

- ShotType, a factor with the following levels: "2P", "3P", "FT" (and NA for events different from shots)
- player, a factor with the name of the player who made the shot
- points, a numeric variable (integer) with the points scored by made shots and 0 for missed shots
- playlength, a numeric variable with time between the shot and the immediately preceding event
- periodTime, a numeric variable with seconds played in the quarter when the shot is attempted
- totalTime, a numeric variable with seconds played in the whole match when the shot is attempted
- shot_distance, a numeric variable with the distance of the shooting player from the basket (in feet)

Value

A ggplot2 plot

Author(s)

Marco Sandri, Paola Zuccolotto, Marica Manisera (<basketballanalyzer.help@unibs.it>)

References

P. Zuccolotto and M. Manisera (2020) Basketball Data Science: With Applications in R. CRC Press.

Examples

```
PbP <- PbPmanipulation(PbP.BDB)
data.team  <- subset(PbP, team=="GSW" & result!="")
densityplot(data=data.team, shot.type="2P", var="playlength", best.scorer=TRUE)
data.opp <- subset(PbP, team!="GSW" & result!="")
densityplot(data=data.opp, shot.type="2P", var="shot_distance", best.scorer=TRUE)
```

---

drawNBAcourt *Add lines of NBA court to an existing ggplot2 plot*

Description

Add lines of NBA court to an existing ggplot2 plot

Usage

```
drawNBAcourt(p, size = 1.5, col = "black", full = FALSE)
```

Arguments

p	a ggplot2 object.
size	numeric, line size.
col	line color.
full	logical; if TRUE draws a complete NBA court; if FALSE draws a half court.

Value

A ggplot2 object

Author(s)

Marco Sandri, Paola Zuccolotto, Marica Manisera (<basketballanalyzer.help@unibs.it>)

Examples

```
library(ggplot2)
p <- ggplot(data.frame(x=0, y=0), aes(x,y)) + coord_fixed()
drawNBAcourt(p)
```

`expectedpts` *Plots expected points of shots as a function of the distance from the basket (default) or another variable*

Description

Plots expected points of shots as a function of the distance from the basket (default) or another variable

Usage

```
expectedpts(
  data,
  var = "shot_distance",
  players = NULL,
  bw = 10,
  period.length = 12,
  palette = gg_color_hue,
  team = TRUE,
  col.team = "gray",
  col.hline = "black",
  xlab = NULL,
  x.range = "auto",
  title = NULL,
  legend = TRUE
)
```

Arguments

`data`	a data frame whose rows are field shots and with the following columns: `points`, `event_type`, `player` (only if the `players` argument is not `NULL`) and at least one of `playlength`, `periodTime`, `totalTime`, `shot_distance` (the column specified in `var`, see Details).
`var`	character, a string giving the name of the numerical variable according to which the expected points are estimated; available options `"playlength"`, `"periodTime"`, `"totalTime"`, `"shot_distance"` (default).
`players`	subset of players to be displayed (optional; it can be used only if the `player` column is present in `data`).
`bw`	numeric, smoothing bandwidth of the kernel density estimator (see `ksmooth`).
`period.length`	numeric, the length of a quarter in minutes (default: 12 minutes as in NBA).
`palette`	color palette.
`team`	logical; if `TRUE`, draws the expected points for all the shots in data.
`col.team`	character, color of the expected points line for all the shots in data (default `"gray"`).

col.hline	character, color of the dashed horizontal line (default "black") denoting the expected points for all the shots in data, not conditional to the variable in the x-axis.
xlab	character, x-axis label.
x.range	numerical vector or character; available options: NULL (x-axis range defined by ggplot2, the default), "auto" (internally defined x-axis range), or a 2-component numerical vector (user-defined x-axis range).
title	character, plot title.
legend	logical, if TRUE, color legend is displayed (only when players is not NULL).

Details

The data data frame could also be a play-by-play dataset provided that rows corresponding to events different from field shots have values different from "shot" or "miss" in the even_type variable.

Required columns:

- event_type, a factor with the following levels: "shot" for made field shots and "miss" for missed field shots
- player, a factor with the name of the player who made the shot
- points, a numeric variable (integer) with the points scored by made shots and 0 for missed shots
- playlength, a numeric variable with time between the shot and the immediately preceding event
- periodTime, a numeric variable with seconds played in the quarter when the shot is attempted
- totalTime, a numeric variable with seconds played in the whole match when the shot is attempted
- shot_distance, a numeric variable with the distance of the shooting player from the basket (in feet)

Value

A ggplot2 plot

Author(s)

Marco Sandri, Paola Zuccolotto, Marica Manisera (<basketballanalyzer.help@unibs.it>)

References

P. Zuccolotto and M. Manisera (2020) Basketball Data Science: With Applications in R. CRC Press.

Examples

```
PbP <- PbPmanipulation(PbP.BDB)
PbP.GSW <- subset(PbP, team=="GSW" & !is.na(shot_distance))
plrys <- c("Stephen Curry","Kevin Durant")
expectedpts(data=PbP.GSW, bw=10, players=plrys, col.team='dodgerblue',
        palette=colorRampPalette(c("gray","black")), col.hline="red")
```

`fourfactors` *Calculates possessions, pace, offensive and defensive rating, and Four Factors*

Description

Calculates possessions, pace, offensive and defensive rating, and Four Factors

Usage

```
fourfactors(TEAM, OPP)
```

Arguments

`TEAM`	a data frame whose rows are the analyzed teams and with columns referred to the team achievements in the considered games (a box score); required variables: `Team`, `P2A`, `P2M`, `P3A`, `P3M`, `FTA`, `FTM`, `OREB`, `DREB`, `TOV`, `MIN` (see Details).
`OPP`	a data frame whose rows are the analyzed teams and with columns referred to the achievements of the opponents of each team in the considered game; required variables: `Team`, `P2A`, `P2M`, `P3A`, `P3M`, `FTA`, `FTM`, `OREB`, `DREB`, `TOV`, `MIN` (see Details).

Details

The rows of the `TEAM` and the `OPP` data frames must be referred to the same teams in the same order.

Required columms:

- `Team`, a factor with the name of the analyzed team
- `P2A`, a numeric variable (integer) with the number of 2-points shots attempted
- `P2M`, a numeric variable (integer) with the number of 2-points shots made
- `P3A`, a numeric variable (integer) with the number of 3-points shots attempted
- `P3M`, a numeric variable (integer) with the number of 3-points shots made
- `FTA`, a numeric variable (integer) with the number of free throws attempted
- `FTM`, a numeric variable (integer) with the number of free throws made

- OREB, a numeric variable (integer) with the number of offensive rebounds
- DREB, a numeric variable (integer) with the number of defensive rebounds
- TOV, a numeric variable (integer) with the number of turnovers
- MIN, a numeric variable (integer) with the number of minutes played

Value

An object of class fourfactors, i.e. a data frame with the following columns:

- Team, a factor with the name of the analyzed team
- POSS.Off, a numeric variable with the number of possessions of each team calculated with the formula $POSS = (P2A + P3A) + 0.44 * FTA - OREB + TOV$
- POSS.Def, a numeric variable with the number of possessions of the opponents of each team calculated with the formula $POSS = (P2A + P3A) + 0.44 * FTA - OREB + TOV$
- PACE.Off, a numeric variable with the pace of each team (number of possessions per minute played)
- PACE.Def, a numeric variable with the pace of the opponents of each team (number of possessions per minute played)
- ORtg, a numeric variable with the offensive rating (the points scored by each team per 100 possessions)
- DRtg, a numeric variable with the defensive rating (the points scored by the opponents of each team per 100 possessions)
- F1.Off, a numeric variable with the offensive first factor (effective field goal percentage)
- F2.Off, a numeric variable with the offensive second factor (turnovers per possession)
- F3.Off, a numeric variable with the offensive third factor (rebouding percentage)
- F4.Off, a numeric variable with the offensive fourth factor (free throw rate)
- F1.Def, a numeric variable with the defensive first factor (effective field goal percentage)
- F2.Def, a numeric variable with the defensive second factor (turnovers per possession)
- F3.Def, a numeric variable with the defensive third factor (rebouding percentage)
- F4.Def, a numeric variable with the defensive fourth factor (free throw rate)

Author(s)

Marco Sandri, Paola Zuccolotto, Marica Manisera (<basketballanalyzer.help@unibs.it>)

References

P. Zuccolotto and M. Manisera (2020) Basketball Data Science: With Applications in R. CRC Press.

See Also

plot.fourfactors

Examples

```
selTeams <- c(2,6,10,11)
FF <- fourfactors(Tbox[selTeams,], Obox[selTeams,])
plot(FF)
```

---

hclustering *Agglomerative hierarchical clustering*

Description

Agglomerative hierarchical clustering

Usage

```
hclustering(data, k = NULL, nclumax = 10, labels = NULL, linkage = "ward.D")
```

Arguments

data	numeric data frame.
k	integer, number of clusters.
nclumax	integer, maximum number of clusters (when k=NULL).
labels	character, row labels.
linkage	character, the agglomeration method to be used in hclust (see method in hclust).

Details

The hclustering function performs a preliminary standardization of columns in data.

Value

A hclustering object.

If k is NULL, the hclustering object is a list of 3 elements:

- k NULL
- clusterRange integer vector, values of k (from 1 to nclumax) at which the *variance between* of the clusterization is evaluated
- VarianceBetween numeric vector, values of the *variance between* evaluated for k in clusterRange

If k is not NULL, the hclustering object is a list of 5 elements:

- k integer, number of clusters
- Subjects data frame, subjects' cluster identifiers
- ClusterList list, clusters' composition
- Profiles data frame, clusters' profiles, i.e. the average of the variables within clusters and the cluster eterogeineity index (CHI)
- Hclust an object of class hclust, see hclust

Author(s)

Marco Sandri, Paola Zuccolotto, Marica Manisera (<basketballanalyzer.help@unibs.it>)

References

P. Zuccolotto and M. Manisera (2020) Basketball Data Science: With Applications in R. CRC Press.

See Also

plot.hclustering, hclust

Examples

```
data <- with(Pbox, data.frame(PTS, P3M, REB=OREB+DREB, AST, TOV, STL, BLK, PF))
data <- subset(data, Pbox$MIN >= 1500)
ID <- Pbox$Player[Pbox$MIN >= 1500]
hclu1 <- hclustering(data)
plot(hclu1)
hclu2 <- hclustering(data, labels=ID, k=7)
plot(hclu2)
```

---

inequality *Inequality analysis*

Description

Inequality analysis

Usage

```
inequality(data, nplayers)
```

Arguments

data	numeric vector containing the achievements (e.g. scored points) of the players whose inequality has to be analyzed.
nplayers	integer, number of players to include in the analysis (ranked in nondecreasing order according to the values in data).

Value

A list with the following elements: Lorenz (cumulative distributions used to plot the Lorenz curve) and Gini (Gini coefficient).

Author(s)

Marco Sandri, Paola Zuccolotto, Marica Manisera (<basketballanalyzer.help@unibs.it>)

References

P. Zuccolotto and M. Manisera (2020) Basketball Data Science: With Applications in R. CRC Press.

See Also

plot.inequality

Examples

```
Pbox.BN <- subset(Pbox, Team=="Brooklyn Nets")
out <- inequality(Pbox.BN$PTS, nplayers=8)
print(out)
plot(out)
```

---

is.assistnet *Reports whether x is a 'networkdata' object*

Description

Reports whether x is a 'networkdata' object

Usage

```
is.assistnet(x)
```

Arguments

x	an object to test.

Value

Returns TRUE if its argument is of class networkdata and FALSE otherwise.

Author(s)

Marco Sandri, Paola Zuccolotto, Marica Manisera (<basketballanalyzer.help@unibs.it>)

References

P. Zuccolotto and M. Manisera (2020) Basketball Data Science: With Applications in R. CRC Press.

See Also

assistnet

Examples

```
PbP <- PbPmanipulation(PbP.BDB)
PbP.GSW <- subset(PbP, team=="GSW" & player!="")
out <- assistnet(PbP.GSW)
is.assistnet(out)
```

---

is.corranalysis *Reports whether x is a 'corranalysis' object*

Description

Reports whether x is a 'corranalysis' object

Usage

```
is.corranalysis(x)
```

Arguments

x	an object to test.

Value

Returns TRUE if its argument is of class corranalysis and FALSE otherwise.

Author(s)

Marco Sandri, Paola Zuccolotto, Marica Manisera (<basketball.analyzer.help@gmail.com>)

References

P. Zuccolotto and M. Manisera (2020) Basketball Data Science: With Applications in R. CRC Press.

See Also

corranalysis

Examples

```
data <- data.frame(Pbox$PTS,Pbox$P3M,Pbox$P2M,
                   Pbox$OREB + Pbox$DREB,Pbox$AST,
                   Pbox$TOV,Pbox$STL,Pbox$BLK)/Pbox$MIN
names(data) <- c("PTS","P3M","P2M","REB","AST","TOV","STL","BLK")
data <- subset(data, Pbox$MIN >= 500)
out <- corranalysis(data)
is.corranalysis(out)
```

`is.fourfactors` *Reports whether x is a 'fourfactors' object*

Description

Reports whether x is a 'fourfactors' object

Usage

```
is.fourfactors(x)
```

Arguments

`x`	an object to test.

Value

Returns TRUE if its argument is of class `fourfactors` and FALSE otherwise.

Author(s)

Marco Sandri, Paola Zuccolotto, Marica Manisera (<basketball.analyzer.help@gmail.com>)

References

P. Zuccolotto and M. Manisera (2020) Basketball Data Science: With Applications in R. CRC Press.

See Also

`fourfactors`

Examples

```
selTeams <- c(2,6,10,11)
out <- fourfactors(Tbox[selTeams,], Obox[selTeams,])
is.fourfactors(out)
```

`is.hclustering` *Reports whether x is a 'hclustering' object*

Description

Reports whether x is a 'hclustering' object

Usage

```
is.hclustering(x)
```

Arguments

`x`	an object to test.

Value

Returns TRUE if its argument is of class `hclustering` and FALSE otherwise.

Author(s)

Marco Sandri, Paola Zuccolotto, Marica Manisera (<basketball.analyzer.help@gmail.com>)

References

P. Zuccolotto and M. Manisera (2020) Basketball Data Science: With Applications in R. CRC Press.

See Also

`hclustering`

Examples

```
data <- data.frame(Pbox$PTS,Pbox$P3M,
                   Pbox$OREB + Pbox$DREB, Pbox$AST,
                   Pbox$TOV, Pbox$STL, Pbox$BLK,Pbox$PF)
names(data) <- c("PTS","P3M","REB","AST","TOV","STL","BLK","PF")
data <- subset(data, Pbox$MIN >= 1500)
ID <- Pbox$Player[Pbox$MIN >= 1500]
hclu <- hclustering(data, labels=ID, k=7)
is.hclustering(hclu)
```

`is.inequality` *Reports whether x is a 'inequality' object.*

Description

Reports whether x is a 'inequality' object.

Usage

```
is.inequality(x)
```

Arguments

x	an object to test.

Value

Returns TRUE if its argument is of class `inequality` and FALSE otherwise.

Author(s)

Marco Sandri, Paola Zuccolotto, Marica Manisera (<basketball.analyzer.help@gmail.com>)

References

P. Zuccolotto and M. Manisera (2020) Basketball Data Science: With Applications in R. CRC Press.

See Also

`inequality`

Examples

```
Pbox.BN <- subset(Pbox, Team=="Brooklyn Nets")
out <- inequality(Pbox.BN$PTS, npl=8)
is.inequality(out)
```

`is.kclustering` *Reports whether x is a 'kclustering' object*

Description

Reports whether x is a 'kclustering' object

Usage

```
is.kclustering(x)
```

Arguments

`x`	an object to test.

Value

Returns TRUE if its argument is of class `kclustering` and FALSE otherwise.

Author(s)

Marco Sandri, Paola Zuccolotto, Marica Manisera (<basketball.analyzer.help@gmail.com>)

References

P. Zuccolotto and M. Manisera (2020) Basketball Data Science: With Applications in R. CRC Press.

See Also

`kclustering`

Examples

```
FF <- fourfactors(Tbox,Obox)
X <- with(FF, data.frame(OD.Rtg=ORtg/DRtg,
               F1.r=F1.Def/F1.Off, F2.r=F2.Off/F2.Def,
               F3.O=F3.Def, F3.D=F3.Off))
X$P3M <- Tbox$P3M
X$STL.r <- Tbox$STL/Obox$STL
kclu <- kclustering(X)
is.kclustering(kclu)
```

`is.MDSmap` *Reports whether x is a 'MDSmap' object*

Description

Reports whether x is a 'MDSmap' object

Usage

```
is.MDSmap(x)
```

Arguments

`x`	an object to test.

Value

Returns TRUE if its argument is of class `MDSmap` and FALSE otherwise.

Author(s)

Marco Sandri, Paola Zuccolotto, Marica Manisera (<basketballanalyzer.help@unibs.it>)

References

P. Zuccolotto and M. Manisera (2020) Basketball Data Science: With Applications in R. CRC Press.

See Also

`MDSmap`

Examples

```
data <- subset(Pbox, MIN >= 1500)
data <- data.frame(data$PTS, data$P3M, data$P2M, data$OREB + data$DREB, data$AST,
                   data$TOV,data$STL, data$BLK)
mds <- MDSmap(data)
is.MDSmap(mds)
```

`is.simplereg` *Reports whether x is a 'simplereg' object*

Description

Reports whether x is a 'simplereg' object

Usage

```
is.simplereg(x)
```

Arguments

`x`	an object to test.

Value

Returns TRUE if its argument is of class `simplereg` and FALSE otherwise.

Author(s)

Marco Sandri, Paola Zuccolotto, Marica Manisera (<basketballanalyzer.help@unibs.it>)

References

P. Zuccolotto and M. Manisera (2020) Basketball Data Science: With Applications in R. CRC Press.

See Also

`simplereg`

Examples

```
Pbox.sel <- subset(Pbox, MIN >= 500)
X <- Pbox.sel$AST/Pbox.sel$MIN
Y <- Pbox.sel$TOV/Pbox.sel$MIN
Pl <- Pbox.sel$Player
out <- simplereg(x=X, y=Y, type="lin")
is.simplereg(out)
```

`is.variability` *Reports whether x is a 'variability' object*

Description

Reports whether x is a 'variability' object

Usage

```
is.variability(x)
```

Arguments

x	an object to test.

Value

Returns TRUE if its argument is of class `variability` and FALSE otherwise.

Author(s)

Marco Sandri, Paola Zuccolotto, Marica Manisera (<basketballanalyzer.help@unibs.it>)

References

P. Zuccolotto and M. Manisera (2020) Basketball Data Science: With Applications in R. CRC Press.

See Also

`variability`

Examples

```
Pbox.BC <- subset(Pbox, Team=="Oklahoma City Thunder" & MIN >= 500,
                  select=c("P2p","P3p","FTp","P2A","P3A","FTA"))
out <- variability(data=Pbox.BC, data.var=c("P2p","P3p","FTp"),
                   size.var=c("P2A","P3A","FTA"), weight=TRUE)
is.variability(out)
```

`kclustering` *K-means cluster analysis*

Description

K-means cluster analysis

Usage

```
kclustering(
  data,
  k = NULL,
  labels = NULL,
  nclumax = 10,
  nruns = 10,
  iter.max = 50,
  algorithm = "Hartigan-Wong"
)
```

Arguments

`data`	numeric data frame.
`k`	integer, number of clusters.
`labels`	character, row labels.
`nclumax`	integer, maximum number of clusters (when `k=NULL`) used for calculating the explained variance as function of the number of clusters.
`nruns`	integer, run the k-means algorithm `nruns` times and chooses the best solution according to a maximum explained variance criterion.
`iter.max`	integer, maximum number of iterations allowed in k-means clustering (see kmeans).
`algorithm`	character, the algorithm used in k-means clustering (see kmeans).

Details

The `kclustering` function performs a preliminary standardization of columns in `data`.

Value

A `kclustering` object.

If `k` is `NULL`, the `kclustering` object is a list of 3 elements:

- `k` `NULL`
- `clusterRange` integer vector, values of `k` (from 1 to `nclumax`) at which the *variance between* of the clusterization is evaluated
- `VarianceBetween` numeric vector, values of the *variance between* evaluated for `k` in `clusterRange`

If k is not NULL, the kclustering object is a list of 4 elements:

- k integer, number of clusters
- Subjects data frame, subjects' cluster identifiers
- ClusterList list, clusters' composition
- Profiles data frame, clusters' profiles, i.e. the average of the variables within clusters and the cluster eterogeineity index (CHI)

Author(s)

Marco Sandri, Paola Zuccolotto, Marica Manisera (<basketballanalyzer.help@unibs.it>)

References

P. Zuccolotto and M. Manisera (2020) Basketball Data Science: With Applications in R. CRC Press.

See Also

plot.kclustering, kmeans

Examples

```
FF <- fourfactors(Tbox,Obox)
X <- with(FF, data.frame(OD.Rtg=ORtg/DRtg,
                F1.r=F1.Def/F1.Off, F2.r=F2.Off/F2.Def,
                F3.O=F3.Def, F3.D=F3.Off))
X$P3M <- Tbox$P3M
X$STL.r <- Tbox$STL/Obox$STL
kclu1 <- kclustering(X)
plot(kclu1)
kclu2 <- kclustering(X, k=9)
plot(kclu2)
```

MDSmap *Multidimensional scaling (MDS) in 2 dimensions*

Description

Multidimensional scaling (MDS) in 2 dimensions

Usage

```
MDSmap(data, std = TRUE)
```

Arguments

data	a numeric matrix, data frame or "dist" object (see dist).
std	logical; if TRUE, data columns are standardized (centered and scaled).

Details

If data is an object of class "dist", std is not active and data is directly inputted into MASS::isoMDS.

Value

An object of class MDSmap, i.e. a list with 4 objects:

- points, a 2-column vector of the fitted configuration (see isoMDS);
- stress, the final stress achieved in percent (see isoMDS);
- data, the input data frame;
- std, the logical std input.

Author(s)

Marco Sandri, Paola Zuccolotto, Marica Manisera (<basketballanalyzer.help@unibs.it>)

References

P. Zuccolotto and M. Manisera (2020) Basketball Data Science: With Applications in R. CRC Press.

See Also

isoMDS, plot.MDSmap.

Examples

```
data <- with(Pbox, data.frame(PTS, P3M, P2M, REB=OREB+DREB, AST, TOV, STL, BLK))
selp <- which(Pbox$MIN >= 1500)
data <- data[selp, ]
id <- Pbox$Player[selp]
mds <- MDSmap(data)
plot(mds, labels=id, z.var="P2M", level.plot=FALSE, palette=rainbow)
```

Obox *Opponents box scores dataset - NBA 2017-2018*

Description

In this data frame cases (rows) are teams and variables (columns) are referred to achievements of the opponents in the NBA 2017-2018 Championship

Usage

```
Obox
```

Format

A data frame with 30 rows and 23 variables:

Team Analyzed team, character

GP Games Played, numeric

MIN Minutes Played, numeric

PTS Points Made, numeric

W Games won, numeric

L Games lost, numeric

P2M 2-Point Field Goals (Made), numeric

P2A 2-Point Field Goals (Attempted), numeric

P2p 2-Point Field Goals (Percentage), numeric

P3M 3-Point Field Goals (Made), numeric

P3A 3-Point Field Goals (Attempted), numeric

P3p 3-Point Field Goals (Percentage), numeric

FTM Free Throws (Made), numeric

FTA Free Throws (Attempted), numeric

FTp Free Throws (Percentage), numeric

OREB Offensive Rebounds, numeric

DREB Defensive Rebounds, numeric

AST Assists, numeric

TOV Turnovers, numeric

STL Steals, numeric

BLK Blocks, numeric

PF Personal Fouls, numeric

PM Plus/Minus, numeric

Author(s)

Marco Sandri, Paola Zuccolotto, Marica Manisera (<basketballanalyzer.help@unibs.it>)

References

P. Zuccolotto and M. Manisera (2020) Basketball Data Science: With Applications in R. CRC Press.

Pbox *Players box scores dataset - NBA 2017-2018*

Description

In this data frame, cases (rows) are players and variables (columns) are referred to the individual achievements in the NBA 2017-2018 Championship

Usage

```
Pbox
```

Format

A data.frame with 605 rows and 22 variables:

Team Analyzed team, character
Player Analyzed player, character
GP Games Played, numeric
MIN Minutes Played, numeric
PTS Points Made, numeric
P2M 2-Point Field Goals (Made), numeric
P2A 2-Point Field Goals (Attempted), numeric
P2p 2-Point Field Goals (Percentage), numeric
P3M 3-Point Field Goals (Made), numeric
P3A 3-Point Field Goals (Attempted), numeric
P3p 3-Point Field Goals (Percentage), numeric
FTM Free Throws (Made), numeric
FTA Free Throws (Attempted), numeric
FTp Free Throws (Percentage), numeric
OREB Offensive Rebounds, numeric
DREB Defensive Rebounds, numeric
AST Assists, numeric
TOV Turnovers, numeric
STL Steals, numeric
BLK Blocks, numeric
PF Personal Fouls, numeric
PM Plus/Minus, numeric

Author(s)

Marco Sandri, Paola Zuccolotto, Marica Manisera (<basketballanalyzer.help@unibs.it>)

References

P. Zuccolotto and M. Manisera (2020) Basketball Data Science: With Applications in R. CRC Press.

PbP.BDB *Play-by-play dataset - NBA 2017-2018*

Description

In this play-by-play data frame (NBA 2017-2018 Championship), the cases (rows) are the events occurred during the analyzed games and the variables (columns) are descriptions of the events in terms of type, time, players involved, score, area of the court.

Usage

```
PbP.BDB
```

Format

A data.frame with 37430 rows and 48 variables:

game_id Identification code for the game

data_set Season: years and type (Regular or Playoffs)

date Date of the game

a1 ... a5; h1 ... h5 Five players on the court (away team; home team)

period Quarter (>= 5: over-time)

away_score; home_score Score of the away/home team

remaining_time Time left in the quarter (h:mm:ss)

elapsed Time played in the quarter (h:mm:ss)

play_length Time since the immediately preceding event (h:mm:ss)

play_id Identification code for the play

team Team responsible for the event

event_type Type of event

assist Player who made the assist

away; home Players for the jump ball

block Player who blocked the shot

entered; left Player who entered/left the court

num Sequence number of the free throw

opponent Player who made the foul

outof Number of free throws accorded

player Player responsible for the event

points Scored points

possession Player who the jump ball is tipped to

reason Reason of the turnover

result Result of the shot (made or missed)

steal Player who stole the ball

type Type of play

shot_distance Field shots: distance from the basket

original_x ; original_y; converted_x ; converted_y Coordinates of the shooting player. `original`: tracking coordinate system half court, (0,0) center of the basket; `converted`: coordinates in feet full court, (0,0) bottom-left corner

description Textual description of the event

Details

This data set has been kindly made available by BigDataBall (www.bigdataball.com), a data provider which leverages computer-vision technologies to richen and extend sports datasets with lots of unique metrics. Since its establishment, BigDataBall has also supported many academic studies and is referred as a reliable source of validated and verified stats for NBA, MLB, NFL and WNBA.

The functions of BasketballAnalyzeR requiring play-by-play data as input need a data frame with some additional variables with respect to PbP.BDB. It can be obtained by means of the function `PbPmanipulation`.

Author(s)

Marco Sandri, Paola Zuccolotto, Marica Manisera (<basketballanalyzer.help@unibs.it>)

Source

https://github.com/sndmrc/BasketballAnalyzeR

References

P. Zuccolotto and M. Manisera (2020) Basketball Data Science: With Applications in R. CRC Press.

PbPmanipulation *Adapts the standard file supplied by BigDataBall to the format required by BasketballAnalyzeR*

Description

Adapts the standard file supplied by BigDataBall to the format required by BasketballAnalyzeR

Usage

```
PbPmanipulation(data, period.length = 12, overtime.length = 5)
```

Arguments

data	a play-by-play data frame supplied by BigDataBall (www.bigdataball.com).
period.length	numeric, the length of a quarter in minutes (default: 12 minutes as in NBA)
overtime.length	numeric, the length of an overtime period in minutes (default: 5 minutes as in NBA)

Value

A play-by-play data frame.

The data frame generated by PbPmanipulation has the same variables of PbP.BDB (when necessary, coerced from one data type to another, e.g from factor to numeric) plus the following five additional variables:

- periodTime, time played in the quarter (in seconds)
- totalTime, time played in the match (in seconds)
- playlength, time since the immediately preceding event (in seconds)
- ShotType, type of shot (FT, 2P, 3P)
- oppTeam, name of the opponent team
- hometeam, name of the home team (generated conditionally on the presence of the variable home_score)

Author(s)

Marco Sandri, Paola Zuccolotto, Marica Manisera (<basketballanalyzer.help@unibs.it>)

References

P. Zuccolotto and M. Manisera (2020) Basketball Data Science: With Applications in R. CRC Press.

See Also

PbP.BDB

Examples

```
PbP <- PbPmanipulation(PbP.BDB)
```

---

plot.assistnet *Plots a network from a 'assistnet' object*

Description

Plots a network from a 'assistnet' object

Usage

```
## S3 method for class 'assistnet'
plot(
  x,
  layout = "kamadakawai",
  layout.par = list(),
  edge.thr = 0,
  edge.col.lim = NULL,
  edge.col.lab = NULL,
  node.size = NULL,
  node.size.lab = NULL,
  node.col = NULL,
  node.col.lim = NULL,
  node.col.lab = NULL,
  node.pal = colorRampPalette(c("white", "blue", "red")),
  edge.pal = colorRampPalette(c("white", "blue", "red")),
  ...
)
```

Arguments

x	an object of class assistnet.
layout	character, network vertex layout algorithm (see gplot.layout) such as "kamadakawai" (the default).
layout.par	a list of parameters for the network vertex layout algorithm (see gplot.layout).
edge.thr	numeric, threshold for edge values; values below the threshold are set to 0.
edge.col.lim	numeric vector of length two providing limits of the scale for edge color.
edge.col.lab	character, label for edge color legend.
node.size	character, indicating the name of the variable for node size (one of the columns of the nodeStats data frame in the x object, see assistnet).

node.size.lab	character, label for node size legend.
node.col	character, indicating the name of the variable for node color (one of the columns of the nodeStats data frame in the x object, see assistnet).
node.col.lim	numeric vector of length two providing limits of the scale for node color.
node.col.lab	character, label for node color legend.
node.pal	color palette for node colors.
edge.pal	color palette for edge colors.
...	other graphical parameters.

Value

A ggplot2 object

Author(s)

Marco Sandri, Paola Zuccolotto, Marica Manisera (<basketballanalyzer.help@unibs.it>)

References

P. Zuccolotto and M. Manisera (2020) Basketball Data Science: With Applications in R. CRC Press.

See Also

assistnet

Examples

```
PbP <- PbPmanipulation(PbP.BDB)
PbP.GSW <- subset(PbP, team=="GSW" & player!="")
out <- assistnet(PbP.GSW)
plot(out, layout="circle", edge.thr=30, node.col="FGM_ASTp", node.size="ASTPTS")
```

---

plot.corranalysis *Plots the correlation matrix and the correlation network from a 'corranalysis' object*

Description

Plots the correlation matrix and the correlation network from a 'corranalysis' object

Usage

```
## S3 method for class 'corranalysis'
plot(x, horizontal = TRUE, title = NULL, ...)
```

Arguments

x	an object of class corranalysis.
horizontal	logical; if TRUE, the two plots are arranged horizontally.
title	character, plot title.
...	other graphical parameters

Value

A ggplot2 object

Author(s)

Marco Sandri, Paola Zuccolotto, Marica Manisera (<basketballanalyzer.help@unibs.it>)

References

P. Zuccolotto and M. Manisera (2020) Basketball Data Science: With Applications in R. CRC Press.

See Also

corranalysis

Examples

```
data <- data.frame(Pbox$PTS,Pbox$P3M,Pbox$P2M,
                   Pbox$OREB + Pbox$DREB,Pbox$AST,
                   Pbox$TOV,Pbox$STL,Pbox$BLK)/Pbox$MIN
names(data) <- c("PTS","P3M","P2M","REB","AST","TOV","STL","BLK")
data <- subset(data, Pbox$MIN >= 500)
out <- corranalysis(data, threshold=0.5)
plot(out)
```

---

plot.fourfactors *Plot possessions, pace, offensive and defensive rating, and Four Factors from a 'fourfactors' object*

Description

Plot possessions, pace, offensive and defensive rating, and Four Factors from a 'fourfactors' object

Usage

```
## S3 method for class 'fourfactors'
plot(x, title = NULL, ...)
```

Arguments

x	an object of class fourfactors.
title	character, plot title.
...	other graphical parameters.

Details

The height of the bars in the two four factor plots are given by the difference between the team value and the average on the analyzed teams.

Value

A list of four ggplot2 plots.

Author(s)

Marco Sandri, Paola Zuccolotto, Marica Manisera (<basketballanalyzer.help@unibs.it>)

References

P. Zuccolotto and M. Manisera (2020) Basketball Data Science: With Applications in R. CRC Press.

See Also

fourfactors

Examples

```
selTeams <- c(2,6,10,11)
FF <- fourfactors(Tbox[selTeams,], Obox[selTeams,])
plot(FF)
```

---

plot.hclustering *Plots hierarchical clustering from a 'hclustering' object*

Description

Plots hierarchical clustering from a 'hclustering' object

Usage

```
## S3 method for class 'hclustering'
plot(
  x,
  title = NULL,
  profiles = FALSE,
  ncol.arrange = NULL,
  circlize = FALSE,
  horiz = TRUE,
  cex.labels = 0.7,
  colored.labels = TRUE,
  colored.branches = FALSE,
  rect = FALSE,
  lower.rect = NULL,
  min.mid.max = NULL,
  ...
)
```

Arguments

x	an object of class hclustering.
title	character or vector of characters (when plotting radial plots of cluster profiles; see Value), plot title(s).
profiles	logical; if TRUE, displays radial plots of cluster profiles (active if x$k is not NULL; see Value).
ncol.arrange	integer, number of columns when arranging multiple grobs on a page (active when plotting radial plots of cluster profiles; see Value).
circlize	logical; if TRUE, plots a circular dendrogram (active when plotting a dendrogram; see Value).
horiz	logical; if TRUE, plots an horizontal dendrogram (active when plotting a non circular dendrogram; see Value).
cex.labels	numeric, the magnification to be used for labels (active when plotting a dendrogram; see Value).
colored.labels	logical; if TRUE, assigns different colors to labels of different clusters (active when plotting a dendrogram; see Value).
colored.branches	logical; if TRUE, assigns different colors to branches of different clusters (active when plotting a dendrogram; see Value).
rect	logical; if TRUE, draws rectangles around the branches in order to highlight the corresponding clusters (active when plotting a dendrogram; see Value).
lower.rect	numeric, a value of how low should the lower part of the rect be (active when plotting a dendrogram; see option lower_rect of rect.dendrogram).
min.mid.max	numeric vector with 3 elements: lower bound, middle dashed line, upper bound for radial axis (active when plotting radial plots of cluster profiles; see Value).
...	other graphical parameters.

Value

If x$k is NULL, plot.hclustering returns a single ggplot2 object, displaying the pattern of the explained variance vs the number of clusters.

If x$k is not NULL and profiles=FALSE, plot.hclustering returns a single ggplot2 object, displaying the dendrogram.

If x$k is not NULL and profiles=TRUE, plot.hclustering returns a list of ggplot2 objects, displaying the radial plots of the cluster profiles.

Author(s)

Marco Sandri, Paola Zuccolotto, Marica Manisera (<basketballanalyzer.help@unibs.it>)

References

P. Zuccolotto and M. Manisera (2020) Basketball Data Science: With Applications in R. CRC Press.

See Also

hclustering, radialprofile.

Examples

```
data <- with(Pbox, data.frame(PTS, P3M, REB=OREB+DREB, AST, TOV, STL, BLK, PF))
data <- subset(data, Pbox$MIN >= 1500)
ID <- Pbox$Player[Pbox$MIN >= 1500]
hclu1 <- hclustering(data)
plot(hclu1)
hclu2 <- hclustering(data, labels=ID, k=7)
plot(hclu2)
```

---

plot.inequality *Plot Lorenz curve from a 'inequality' object*

Description

Plot Lorenz curve from a 'inequality' object

Usage

```
## S3 method for class 'inequality'
plot(x, title = NULL, ...)
```

Arguments

x	an object of class inequality.
title	character, plot title.
...	other graphical parameters.

Value

A ggplot2 object.

Author(s)

Marco Sandri, Paola Zuccolotto, Marica Manisera (<basketballanalyzer.help@unibs.it>)

References

P. Zuccolotto and M. Manisera (2020) Basketball Data Science: With Applications in R. CRC Press.

See Also

inequality

Examples

```
Pbox.BN <- subset(Pbox, Team=="Brooklyn Nets")
out <- inequality(Pbox.BN$PTS, nplayers=8)
print(out)
plot(out)
```

---

plot.kclustering *Plot k-means clustering from a 'kclustering' object*

Description

Plot k-means clustering from a 'kclustering' object

Usage

```
## S3 method for class 'kclustering'
plot(
  x,
  title = NULL,
  ncol.arrange = NULL,
  min.mid.max = NULL,
  label.size = 2.5,
  ...
)
```

Arguments

x	an object of class kclustering.
title	character or vector of characters (when plotting radial plots of cluster profiles; see Value), plot title(s).

ncol.arrange	integer, number of columns when arranging multiple grobs on a page (active when plotting radial plots of cluster profiles; see Value).
min.mid.max	numeric vector with 3 elements: lower bound, middle dashed line, upper bound for radial axis (active when plotting radial plots of cluster profiles; see Value).
label.size	numeric; label font size (default 2.5).
...	other graphical parameters.

Value

If x$k is NULL, plot.kclustering returns a single ggplot2 object, displaying the pattern of the explained variance vs the number of clusters.

If x$k is not NULL, plot.kclustering returns a list of ggplot2 objects, displaying the radial plots of the cluster profiles.

Author(s)

Marco Sandri, Paola Zuccolotto, Marica Manisera (<basketballanalyzer.help@unibs.it>)

References

P. Zuccolotto and M. Manisera (2020) Basketball Data Science: With Applications in R. CRC Press.

See Also

kclustering, radialprofile

Examples

```
FF <- fourfactors(Tbox,Obox)
X <- with(FF, data.frame(OD.Rtg=ORtg/DRtg,
               F1.r=F1.Def/F1.Off, F2.r=F2.Off/F2.Def,
               F3.O=F3.Def, F3.D=F3.Off))
X$P3M <- Tbox$P3M
X$STL.r <- Tbox$STL/Obox$STL
kclu1 <- kclustering(X)
plot(kclu1)
kclu2 <- kclustering(X, k=9)
plot(kclu2)
```

---

plot.MDSmap *Draws two-dimensional plots for multidimensional scaling (MDS) from a 'MDSmap' object*

Description

Draws two-dimensional plots for multidimensional scaling (MDS) from a 'MDSmap' object

Usage

```
## S3 method for class 'MDSmap'
plot(
  x,
  z.var = NULL,
  level.plot = TRUE,
  title = NULL,
  labels = NULL,
  repel_labels = FALSE,
  text_label = TRUE,
  label_size = 3,
  subset = NULL,
  col.subset = "gray50",
  zoom = NULL,
  palette = NULL,
  contour = FALSE,
  ncol.arrange = NULL,
  ...
)
```

Arguments

x	an object of class MDSmap.
z.var	character vector; defines the set of variables (available in the data data frame of MDSmap) used to color-coding the points in the map (for scatter plots) or, alternatively, overlap to the map a colored level plot.
level.plot	logical; if TRUE, draws a level plot, otherwise draws a scatter plot (not active if zvar=NULL).
title	character, plot title.
labels	character vector, labels for (x, y) points (only for single scatter plot).
repel_labels	logical; if TRUE, draw text labels using repelling (not for highlighted points) (see geom_text_repel).
text_label	logical; if TRUE, draw a rectangle behind the text labels (not active if subset=NULL).
label_size	numeric; label font size (default label_size=3, for scatter plots).
subset	logical vector, to select a subset of points to be highlighted.
col.subset	character, color for the subset of points.
zoom	numeric vector with 4 elements; c(xmin,xmax,ymin,ymax) for the x- and y-axis limits of the plot.
palette	color palette.
contour	logical; if TRUE, contour lines are plotted (not active if level.plot=FALSE).
ncol.arrange	integer, number of columns when arranging multiple grobs on a page.
...	other graphical parameters.

Value

A single ggplot2 plot or a list of ggplot2 plots

Author(s)

Marco Sandri, Paola Zuccolotto, Marica Manisera (<basketballanalyzer.help@unibs.it>)

References

P. Zuccolotto and M. Manisera (2020) Basketball Data Science: With Applications in R. CRC Press.

See Also

MDSmap

Examples

```
data <- data.frame(Pbox$PTS, Pbox$P3M, Pbox$P2M, Pbox$OREB + Pbox$DREB, Pbox$AST,
Pbox$TOV,Pbox$STL, Pbox$BLK)
names(data) <- c('PTS','P3M','P2M','REB','AST','TOV','STL','BLK')
selp <- which(Pbox$MIN >= 1500)
data <- data[selp,]
id <- Pbox$Player[selp]
mds <- MDSmap(data)
plot(mds, labels=id, z.var="P2M", level.plot=FALSE, palette=rainbow)
```

---

plot.simplereg *Plot simple regression from a 'simplereg' object*

Description

Plot simple regression from a 'simplereg' object

Usage

```
## S3 method for class 'simplereg'
plot(
  x,
  labels = NULL,
  subset = NULL,
  Lx = 0.01,
  Ux = 0.99,
  Ly = 0.01,
  Uy = 0.99,
  title = "Simple regression",
  xtitle = NULL,
  ytitle = NULL,
  repel = TRUE,
```

```
  ...
)
```

Arguments

x	an object of class simplereg.
labels	character, labels for subjects.
subset	an optional vector specifying a subset of observations to be highlighted in the graph or subset='quant' to highligh observations with coordinates above and below the upper and lower quantiles of the variables on the x- and y-axis (Lx, Ux, Ly, Uy).
Lx	numeric; if subset='quant', lower quantile for the variable on the x-axis (default = 0.01).
Ux	numeric; if subset='quant', upper quantile for the variable on the x-axis (default = 0.99).
Ly	numeric; if subset='quant', lower quantile for the variable on the y-axis (default = 0.01).
Uy	numeric; if subset='quant', upper quantile for the variable on the y-axis (default = 0.99).
title	character, plot title.
xtitle	character, x-axis label.
ytitle	character, y-axis label.
repel	logical, if TRUE (the default) text labels repel away from each other.
...	other graphical parameters.

Value

A ggplot2 object

Author(s)

Marco Sandri, Paola Zuccolotto, Marica Manisera (<basketballanalyzer.help@unibs.it>)

References

P. Zuccolotto and M. Manisera (2020) Basketball Data Science: With Applications in R. CRC Press.

See Also

simplereg

Examples

```
Pbox.sel <- subset(Pbox, MIN >= 500)
X <- Pbox.sel$AST/Pbox.sel$MIN
Y <- Pbox.sel$TOV/Pbox.sel$MIN
Pl <- Pbox.sel$Player
mod <- simplereg(x=X, y=Y, type="lin")
plot(mod)
```

`plot.variability` *Plots a variability diagram from a 'variability' object*

Description

Plots a variability diagram from a 'variability' object

Usage

```
## S3 method for class 'variability'
plot(
  x,
  title = "Variability diagram",
  ylim = NULL,
  ylab = NULL,
  size.lim = NULL,
  max.circle = 25,
  n.circle = 4,
  leg.brk = NULL,
  leg.pos = "right",
  leg.just = "left",
  leg.nrow = NULL,
  leg.title = NULL,
  leg.title.pos = "top",
  ...
)
```

Arguments

`x`	an aobject of class `variability`.
`title`	character, plot title.
`ylim`	numeric vector of length two, y-axis limits.
`ylab`	character, y-axis label.
`size.lim`	numeric vector of length two, set limits of the bubbles' size scale (see `limits` of `scale_size`).
`max.circle`	numeric, maximum size of the `size` plotting symbol (see `range` of `scale_size`).
`n.circle`	integer; if `leg.brk=NULL`, set a sequence of about `n.circle+1` equally spaced 'round' values which cover the range of the values used to set the bubbles' size.

leg.brk	numeric vector, breaks for bubbles' size legend (see breaks of scale_size).
leg.pos	character or numeric vector of length two, legend position; available options "none", "left", "right" (default), "bottom", "top", or a c(x,y) numeric vector (x and y are coordinates of the legend box; their values should be between 0 and 1; c(0,0) corresponds to the bottom-left and c(1,1) corresponds to the top-right position).
leg.just	character or numeric vector of length two; anchor point for positioning legend inside plot ("left" (default), "center", "right" or two-element numeric vector) or the justification according to the plot area when positioned outside the plot.
leg.nrow	integer, number of rows of the bubbles' size legend.
leg.title	character, title of the bubbles' size legend.
leg.title.pos	character, position of the legend title; available options: "top" (default for a vertical legend), "bottom", "left" (default for a horizontal legend), or "right".
...	other graphical parameters.

Value

A ggplot2 object

Author(s)

Marco Sandri, Paola Zuccolotto, Marica Manisera (<basketballanalyzer.help@unibs.it>)

References

P. Zuccolotto and M. Manisera (2020) Basketball Data Science: With Applications in R. CRC Press.

See Also

variability

Examples

```
Pbox.BC <- subset(Pbox, Team=="Oklahoma City Thunder" & MIN >= 500,
                  select=c("P2p","P3p","FTp","P2A","P3A","FTA"))
out <- variability(data=Pbox.BC, data.var=c("P2p","P3p","FTp"),
                   size.var=c("P2A","P3A","FTA"), weight=TRUE)
plot(out, leg.brk=c(10,25,50,100,500,1000), max.circle=30)
```

`radialprofile` *Draws radial plots for player profiles*

Description

Draws radial plots for player profiles

Usage

```
radialprofile(
  data,
  perc = FALSE,
  std = TRUE,
  title = NULL,
  ncol.arrange = NULL,
  min.mid.max = NULL,
  label.size = 2.5
)
```

Arguments

`data`	a data frame.
`perc`	logical; if `perc=TRUE`, `std=FALSE` and `min.mid.max=NULL`, set axes range between 0 and 100 and set the middle dashed line at 50.
`std`	logical; if `std=TRUE`, variables are preliminarily standardized.
`title`	character vector, titles for radial plots.
`ncol.arrange`	integer, number of columns in the grid of arranged plots.
`min.mid.max`	numeric vector with 3 elements: lower bound, middle dashed line, upper bound for radial axis.
`label.size`	numeric; label font size (default 2.5).

Value

A list of `ggplot2` radial plots or, if `ncol.arrange=NULL`, a single `ggplot2` plot of arranged radial plots

Author(s)

Marco Sandri, Paola Zuccolotto, Marica Manisera (<basketball.analyzer.help@gmail.com>)

References

P. Zuccolotto and M. Manisera (2020) Basketball Data Science: With Applications in R. CRC Press.

See Also

`plot.kclustering`

Examples

```
data("Pbox")
Pbox.PG <- Pbox[1:6,]
X <- data.frame(Pbox.PG$P2M, Pbox.PG$P3M, Pbox.PG$OREB+Pbox.PG$DREB,
                Pbox.PG$AST, Pbox.PG$TO)/Pbox.PG$MIN
names(X) <- c("P2M","P3M","REB","AST","TO")
radialprofile(data=X, ncol.arrange=3, title=Pbox.PG$Player)
```

`scatterplot` *Draws a scatter plot or a matrix of scatter plots*

Description

Draws a scatter plot or a matrix of scatter plots

Usage

```
scatterplot(
  data,
  data.var,
  z.var = NULL,
  palette = NULL,
  labels = NULL,
  repel_labels = FALSE,
  text_label = TRUE,
  label_size = 3,
  subset = NULL,
  col.subset = "gray50",
  zoom = NULL,
  title = NULL,
  legend = TRUE,
 upper = list(continuous = "cor", combo = "box_no_facet", discrete = "facetbar", na =
    "na"),
 lower = list(continuous = "points", combo = "facethist", discrete = "facetbar", na =
    "na"),
  diag = list(continuous = "densityDiag", discrete = "barDiag", na = "naDiag")
)
```

Arguments

`data`	an object of class `data.frame`.
`data.var`	character or numeric vector, name or column number of variables (in `data` object) used on the axes of scatter plot(s).
`z.var`	character or number, name or column number of variable (in `data` object) used to assign colors to points (see Details).
`palette`	color palette (active when plotting a single scatter plot; see Value).

labels	character vector, labels for points (active when plotting a single scatter plot, see Value).
repel_labels	logical; if TRUE, draws text labels of not highlighted points using repelling (active when plotting a single scatter plot; see Value).
text_label	logical; if TRUE, draws a rectangle behind the labels of highlighted points (active when plotting a single scatter plot; see Value).
label_size	numeric; label font size (default label_size=3).
subset	logical or numeric vector, to select a subset of points to be highlighted (active when plotting a single scatter plot; see Value).
col.subset	character, color for the labels and rectangles of highlighted points (active when plotting a single scatter plot; see Value).
zoom	numeric vector with 4 elements; c(xmin,xmax,ymin,ymax) for the x- and y-axis limits of the plot (active when plotting a single scatter plot; see Value).
title	character, plot title.
legend	logical, if legend=FALSE legend is removed (active when plotting a single scatter plot with z.var not NULL; see Value).
upper	list, may contain the variables continuous, combo, discrete, and na (active when plotting a matrix of scatter plot; see Value and upper in ggpairs)
lower	list, may contain the variables continuous, combo, discrete, and na (active when plotting a matrix of scatter plot; see Value and lower in ggpairs)
diag	list, may contain the variables continuous, discrete, and na (active when plotting a matrix of scatter plot; see Value and diag in ggpairs)

Details

If length(data.var)=2, the variable specified in z.var can be numeric or factor; if length(data.var)>2, the variable specified in z.var must be a factor.

Value

A ggplot2 object with a single scatter plot if length(data.var)=2 or a matrix of scatter plots if length(data.var)>2.

Author(s)

Marco Sandri, Paola Zuccolotto, Marica Manisera (<basketball.analyzer.help@gmail.com>)

References

P. Zuccolotto and M. Manisera (2020) Basketball Data Science: With Applications in R. CRC Press.

See Also

ggpairs

Examples

```
# Single scatter plot
Pbox.sel <- subset(Pbox, MIN>= 500)
X <- data.frame(AST=Pbox.sel$AST/Pbox.sel$MIN,TOV=Pbox.sel$TOV/Pbox.sel$MIN)
X$PTSpm <- Pbox.sel$PTS/Pbox.sel$MIN
mypal <- colorRampPalette(c("blue","yellow","red"))
scatterplot(X, data.var=c("AST","TOV"), z.var="PTSpm", labels=1:nrow(X), palette=mypal)
# Matrix of scatter plots
data <- Pbox[1:50, c("PTS","P3M","P2M","OREB","Team")]
scatterplot(data, data.var=1:4, z.var="Team")
```

`scoringprob` *Plots scoring probability of shots as a function of a given variable*

Description

Plots scoring probability of shots as a function of a given variable

Usage

```
scoringprob(
  data,
  var,
  shot.type,
  players = NULL,
  bw = 20,
  period.length = 12,
  xlab = NULL,
  x.range = "auto",
  title = NULL,
  palette = gg_color_hue,
  team = TRUE,
  col.team = "dodgerblue",
  legend = TRUE
)
```

Arguments

`data`	a data frame whose rows are shots and with the following columns: `result`, `ShotType`, `player` (only if the `players` argument is not `NULL`) and at least one of `playlength`, `periodTime`, `totalTime`, `shot_distance` (the column specified in `var`, see Details).
`var`	character, the string giving the name of the numerical variable according to which the scoring probability is estimated. Available options: `"playlength"`, `"periodTime"`, `"totalTime"`, `"shot_distance"`.
`shot.type`	character, the type of shots to be analyzed; available options: `"2P"`, `"3P"`, `"FT"`, `"field"`.

players	subset of players to be displayed (optional; it can be used only if the player column is present in data).
bw	numeric, the smoothing bandwidth of the kernel density estimator (see ksmooth).
period.length	numeric, the length of a quarter in minutes (default: 12 minutes as in NBA).
xlab	character, x-axis label.
x.range	numerical vector or character; available options: NULL (x-axis range defined by ggplot2, the default), "auto" (internally defined x-axis range), or a 2-component numerical vector (user-defined x-axis range).
title	character, plot title.
palette	color palette.
team	character; if TRUE draws the scoring probability for all the shots in data.
col.team	character, color of the scoring probability line for all the shots in data.
legend	character; if TRUE, color legend is displayed (only when players is not NULL).

Details

The data data frame could also be a play-by-play dataset provided that rows corresponding to events different from shots have NA in the ShotType variable.

Required columns:

- result, a factor with the following levels: "made" for made shots, "miss" for missed shots, and "" for events different from shots
- ShotType, a factor with the following levels: "2P", "3P", "FT" (and NA for events different from shots)
- player, a factor with the name of the player who made the shot
- playlength, a numeric variable with time between the shot and the immediately preceding event
- periodTime, a numeric variable with seconds played in the quarter when the shot is attempted
- totalTime, a numeric variable with seconds played in the whole match when the shot is attempted
- shot_distance, a numeric variable with the distance of the shooting player from the basket (in feet)

Value

A ggplot2 plot

Author(s)

Marco Sandri, Paola Zuccolotto, Marica Manisera (<basketballanalyzer.help@unibs.it>)

References

P. Zuccolotto and M. Manisera (2020) Basketball Data Science: With Applications in R. CRC Press.

Examples

```
PbP <- PbPmanipulation(PbP.BDB)
PbP.GSW <- subset(PbP, team=="GSW" & result!="")
players <- c("Kevin Durant","Draymond Green","Klay Thompson")
scoringprob(data=PbP.GSW, shot.type="2P", players=players,
            var="shot_distance", col.team="gray")
```

---

shotchart *Plots different kinds of charts based on shot coordinates*

Description

Plots different kinds of charts based on shot coordinates

Usage

```
shotchart(
  data,
  x,
  y,
  z = NULL,
  z.fun = median,
  result = NULL,
  type = NULL,
  scatter = FALSE,
  num.sect = 7,
  n = 1000,
  col.limits = c(NA, NA),
  courtline.col = "black",
  bg.col = "white",
  sectline.col = "white",
  text.col = "white",
  legend = FALSE,
  drop.levels = TRUE,
  pt.col = "black",
  pt.alpha = 0.5,
  nbins = 25,
  palette = "mixed"
)
```

Arguments

data	A data frame whose rows are field shots and columns are half-court shot coordinates x and y, and optionally additional variables to be specified in z and/or result (see Details).
x	character, indicating the variable name of the x coordinate.
y	character, indicating the variable name of the y coordinate.
z	character, indicating the name of the variable used to color the points (if type=NULL) or the sectors (if type="sectors", in this case z must be a numeric variable).
z.fun	function (active when type="sectors"), used to summarize the values of z variable within each sector (recommended: mean, median).
result	character (active when type="sectors" and scatter=FALSE), indicating the name of the factor with the shot result (allowed categories made and missed).
type	character, indicating the plot type; available option are NULL, "sectors", "density-polygons", "density-raster", "density-hexbin".
scatter	logical, if TRUE a scatter plot of the shots is added to the plot.
num.sect	integer (active when type="sectors"), number of sectors.
n	integer (active when type="sectors"), number of points used to draw arcs (must be > 500).
col.limits	numeric vector, (active when z is a numeric variable), limits c(min, max) for the gradient color scale of z variable.
courtline.col	color of court lines.
bg.col	background color.
sectline.col	color of sector lines (active when type="sectors").
text.col	color of text annotation within sectors (active when type="sectors").
legend	logical, if TRUE a legend for z is plotted.
drop.levels	logical, if TRUE unused levels of the z variable are dropped.
pt.col	color of points in the scatter plot.
pt.alpha	numeric, transparency of points in the scatter plot.
nbins	integer (active when type="density-hexbin"), number of bins.
palette	color palette; available options "main", "cool", "hot", "mixed", "grey", "bwr" (blue, white, red).

Details

The data dataframe could also be a play-by-play dataset provided that rows corresponding to events different from field shots have missing x and y coordinates.

x and y coordinates must be expressed in feets; the origin of the axes is positioned at the center of the field.

Value

A ggplot2 object.

Author(s)

Marco Sandri, Paola Zuccolotto, Marica Manisera (<basketball.analyzer.help@gmail.com>)

References

P. Zuccolotto and M. Manisera (2020) Basketball Data Science: With Applications in R. CRC Press.

See Also

drawNBAcourt, geom_density_2d, geom_hex

Examples

```
PbP <- PbPmanipulation(PbP.BDB)
subdata <- subset(PbP, player=="Kevin Durant")
subdata$xx <- subdata$original_x/10
subdata$yy <- subdata$original_y/10-41.75
shotchart(data=subdata, x="xx", y="yy", scatter=TRUE)
shotchart(data=subdata, x="xx", y="yy", scatter=TRUE, z="result")
shotchart(data=subdata, x="xx", y="yy", scatter=TRUE, z="result",
          bg.col="black", courtline.col="white", palette="hot")
shotchart(data=subdata, x="xx", y="yy", result="result",
          type="sectors", sectline.col="gray", text.col="red")
shotchart(data=subdata, x="xx", y="yy", z="playlength", result="result",
          type="sectors",  num.sect=5)
shotchart(data=subdata, x="xx", y="yy", type="density-polygons", palette="bwr")
shotchart(data=subdata, x="xx", y="yy", type="density-raster",
          scatter=TRUE, pt.col="tomato", pt.alpha=0.1)
shotchart(data=subdata, x="xx", y="yy", type="density-hexbin", nbins=30)
```

---

simplereg *Simple linear and nonparametric regression*

Description

Simple linear and nonparametric regression

Usage

```
simplereg(x, y, type = "lin", sp = NULL)
```

Arguments

x	numerical vector, input x values.
y	numerical vector, input y values.
type	character, type of regression; available options are: lin (linear regression, the default), pol (local polynomial regression of degree 2), ks (nonparametric kernel smoothing).
sp	numeric, parameter to control the degree of smoothing; span for local polynomial regression and bandwidth for ksmooth.

Value

An object of class `simplereg`, i.e. a list with the following objects:

- `Model`, the output model (linear regression, local polynomial regression, or kernel smoothing)
- `R2`, (in-sample) coefficient of determination
- `x`, input x values
- `y`, input y values
- `type`, type of regression

Author(s)

Marco Sandri, Paola Zuccolotto, Marica Manisera (<basketball.analyzer.help@gmail.com>)

References

P. Zuccolotto and M. Manisera (2020) Basketball Data Science: With Applications in R. CRC Press.

See Also

`loess`, `ksmooth`

Examples

```
Pbox.sel <- subset(Pbox, MIN >= 500)
X <- Pbox.sel$AST/Pbox.sel$MIN
Y <- Pbox.sel$TOV/Pbox.sel$MIN
Pl <- Pbox.sel$Player
mod <- simplereg(x=X, y=Y, type="lin")
```

Tadd *Tadd dataset - NBA 2017-2018*

Description

In this data frame, the cases (rows) are the analyzed teams and the variables (columns) are qualitative information such as Conference, Division, final rank, qualification for Playoffs for the NBA 2017-2018 Championship.

Usage

```
Tadd
```

Format

A data frame with 30 rows and 6 variables:

Team Analyzed team (long name), factor

team Analyzed team (short name), factor

Conference Conference, factor

Division Division, factor

Rank Rank (end season), numeric

Playoff Playoff qualification (Yes or No), factor

Author(s)

Marco Sandri, Paola Zuccolotto, Marica Manisera (<basketballanalyzer.help@unibs.it>)

References

P. Zuccolotto and M. Manisera (2020) Basketball Data Science: With Applications in R. CRC Press.

Tbox *Teams box scores dataset - NBA 2017-2018*

Description

In this data frame, cases (rows) are teams and variables (columns) are referred to team achievements in the different games in the NBA 2017-2018 Championship.

Usage

```
Tbox
```

Format

A data frame with 30 rows and 23 variables:

Team Analyzed team, character

GP Games Played, numeric

MIN Minutes Played, numeric

PTS Points Made, numeric

W Games won, numeric

L Games lost, numeric

P2M 2-Point Field Goals (Made), numeric

P2A 2-Point Field Goals (Attempted), numeric

P2p 2-Point Field Goals (Percentage), numeric

P3M 3-Point Field Goals (Made), numeric

P3A 3-Point Field Goals (Attempted), numeric

P3p 3-Point Field Goals (Percentage), numeric

FTM Free Throws (Made), numeric

FTA Free Throws (Attempted), numeric

FTp Free Throws (Percentage), numeric

OREB Offensive Rebounds, numeric

DREB Defensive Rebounds, numeric

AST Assists, numeric

TOV Turnovers, numeric

STL Steals, numeric

BLK Blocks, numeric

PF Personal Fouls, numeric

PM Plus/Minus, numeric

Author(s)

Marco Sandri, Paola Zuccolotto, Marica Manisera (<basketballanalyzer.help@unibs.it>)

References

P. Zuccolotto and M. Manisera (2020) Basketball Data Science: With Applications in R. CRC Press.

`TOPboxes` *Calculate Team, Opponents and Players box scores (Tbox, Obox and Pbox)*

Description

Calculate Team, Opponents and Players box scores (Tbox, Obox and Pbox)

Usage

```
TOPboxes(data, team)
```

Arguments

`data`	a data frame containing play-by-play data (see Details)
`team`	character, indicating the name of the team

Details

To compute Tbox and Obox, the function needs the following variables: game_id, playlength, ShotType, points, result, team, oreb, dreb, PF, turnover, assist, block and steal. If any of these variables is missing, an error message is displayed.

To compute Pbox, also the variables player, a1 . . . a5, h1 . . . h5 and hometeam are needed. If any is omitted, only Tbox and Obox are given in output.

Note that the variables assist, block and steal can contain the logical indicator of whether the corresponding event has occurred (TRUE/FALSE or numerical 0/1) or the name of the involved player (character). In the former case, Tbox and Obox are fully computed, while the variables AST, BLK and STL are missing in the Pbox data frame. In the latter case, all the data frames Tbox, Obox and Pbox are fully computed.

TOPboxes omits the computation of the variables W (Games won) and L (Games lost). In fact, since we aim at computing box scores starting from whatever portion of play-by-play data (e.g., only a part of a game), in some cases, calculating the number of won and lost games does not make sense.

Value

A list with the following elements

- Tbox, the data frame of team box scores
- Obox, the data frame of opponents box scores
- Pbox, the data frame of player box scores

Author(s)

Marco Sandri, Paola Zuccolotto, Marica Manisera (<basketballanalyzer.help@unibs.it>)

References

P. Zuccolotto, M. Manisera and M. Sandri (2026) Advanced Basketball Data Science: With Applications in R. CRC Press.

P. Zuccolotto and M. Manisera (2020) Basketball Data Science: With Applications in R. CRC Press.

See Also

PbPmanipulation

Examples

```
library(operators)
library(dplyr)
PbP <- PbPmanipulation(PbP.BDB)
PbP <- PbP %>%
  mutate(oreb = type %~% "rebound offensive",
         dreb = type %~% "rebound defensive",
                turnover = event_type=="turnover",
                PF = (event_type == "foul") & !(type %~% "technical") ) %>%
```

```
        mutate(across(c(player, assist, steal, block, h1:h5, a1:a5), as.character)) %>%
 as.data.frame()
out <- TOPboxes(PbP, team="GSW")
```

`variability` *Variability analysis*

Description

Variability analysis

Usage

```
variability(data, data.var, size.var, VC = TRUE, weight = FALSE)
```

Arguments

`data`	a data frame.
`data.var`	a vector of variable names or of column numbers defining (numeric) variables whose variability will be analyzed by `variability`.
`size.var`	a vector of variable names or of column numbers defining variables for weights (active only if `weight=TRUE`).
`VC`	logical; if `TRUE`, calculates variation coefficients of variables in `data.var`.
`weight`	logical; if TRUE, calculates weighted variation coefficients and standard deviations.

Value

A list with the following elements: ranges, standard deviations, variation coefficients, and two dataframes (data, size).

Author(s)

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Examples

```
Pbox.BC <- subset(Pbox, Team=="Oklahoma City Thunder" & MIN >= 500,
                  select=c("P2p","P3p","FTp","P2A","P3A","FTA"))
list_variability <- variability(data=Pbox.BC, data.var=c("P2p","P3p","FTp"),
                                size.var=c("P2A","P3A","FTA"), weight=TRUE)
print(list_variability)
plot(list_variability, leg.brk=c(10,25,50,100,500,1000), max.circle=30)
```

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