Package ‘PlotsR’

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Version 3.0

Title Plots with R

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Description Makes it possible to perform many different plots using graphical functions of R.

License GPL (>= 2)

Encoding UTF-8

Depends R (>= 3.2)

R topics documented:

`adworld` *Geographical coordinates*

Description

Latitude and longitude of all administrative areas.

Usage

```
data(adworld)
```

Format

A matrix of many rows and 3 columns (Latitude, Longitude and name of the administrative area)

Source

Latitude and longitude coordinates of the administrative areas were obtained from the web page https://www.openstreetmap.org.

`F1` *SIMPLE SCATTER PLOT FOR VARIABLE X QUANTITATIVE*

Description

It performs a simple scatter plot with or without text labels and a regression model.

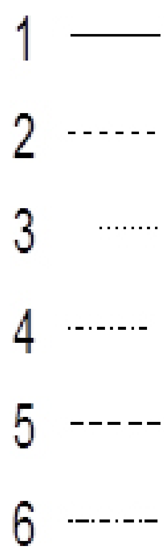
Usage

```
F1(data, varY, varX, textlabel=NULL, label=NULL, reg=FALSE, model="Linear",
outliers=FALSE, quant1=0.05, quant2=0.95, ci=TRUE, level=0.95, ResetPAR=TRUE,
PAR=NULL, XLAB=NULL, YLAB=NULL, COLOR="black", COLORR="red", PCH=16, lty=1,
ltyci=2, lwd=2.5, R2.pos="topleft", PLOT=NULL, LEGEND=NULL, AXIS=NULL,
MTEXT=NULL, TEXT=NULL, dec=",", file="Output.txt")
```

Arguments

`data`	Data file.
`varY`	Dependent variable.
`varX`	Quantitative independent variable.
`textlabel`	Variable with the text labels.
`label`	It allows to specify the characteristics of the text labels with the function text.
`reg`	If TRUE a regression model is performed.
`model`	One regression model can be selected: "Linear" , "Log", "S-curve", "Power", "Exp", "Quadratic", "Cubic", "Inverse". It is not considered the model in those cases in which there is the logarithm that apply to any of the variables, if any value of the variable, which applies the logarithm, is zero or negative. The inverse model is not calculated if any value of the independent variable is zero.
`outliers`	If it is TRUE, the outliers are removed using the selected regression model.
`quant1`	Quantile of the lower end to the elimination of outliers.
`quant2`	Quantile of the upper end to the elimination of outliers.
`ci`	If it is TRUE the confidence interval is depicted, but only for the linear regression model.
`level`	Tolerance/confidence level.
`ResetPAR`	If it is FALSE, the default condition of the function PAR is not placed and maintained those defined by the user in previous graphics.
`PAR`	It accesses the function PAR that allows to modify many different aspects of the graph.
`XLAB`	Legend of the X axis.
`YLAB`	Legend of the Y axis.
`COLOR`	Color of the symbols.
`COLORR`	Color of the line of the regression model.
`PCH`	Graphic symbol (see the figure below).

`lty` Type of the regression line (see the figure below).



`ltyci` Type of the confidence interval line (see above figure).

`lwd` Line width of the regression line.

`R2.pos` If it is not NULL, with this argument is possible to specify the position of the r^2 of the regression in the scatter plot.

`PLOT` It allows to specify the characteristics of the function plot.default.

`LEGEND` It allows to include a legend to the graph.

`AXIS` It allows to add axes to the graph.

`MTEXT` It allows to add text on the margins of the graph.

`TEXT`	It allows to add text in any area of the inner part of the graph.
`dec`	It defines if the comma "," is used as decimal separator or the dot ".".
`file`	TXT FILE. If the argument *reg=TRUE* a TXT file is saved with the information of the regression.

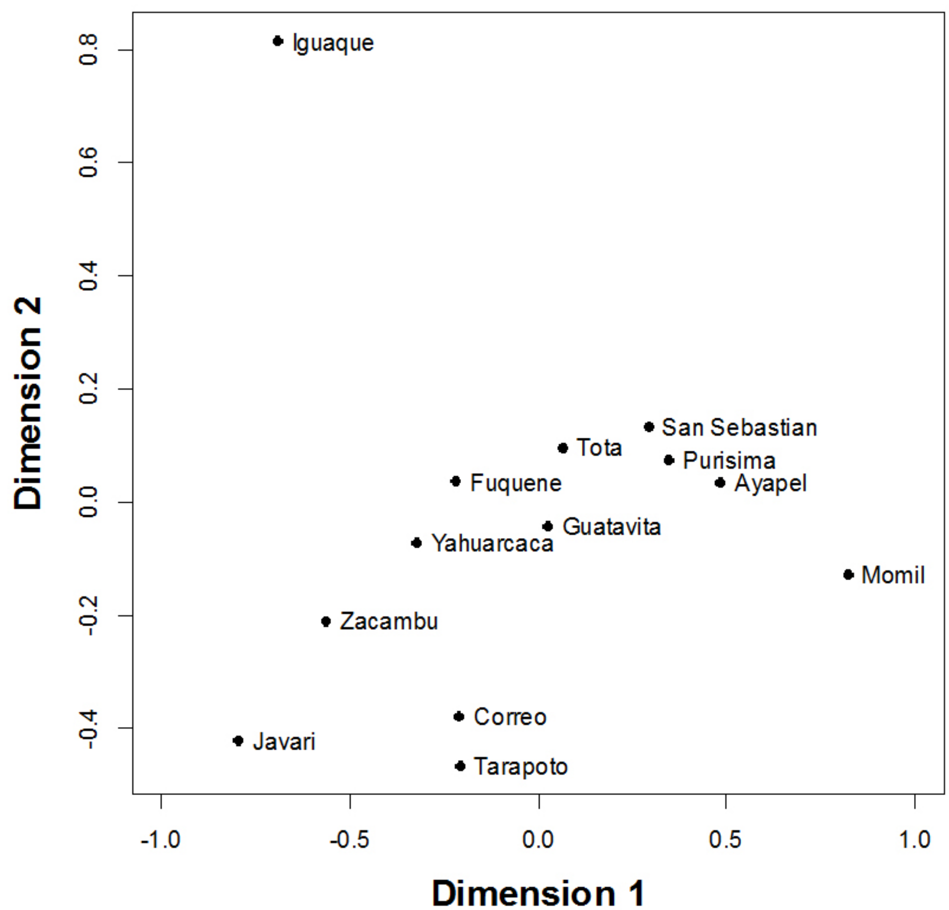
Details

FUNCTIONS

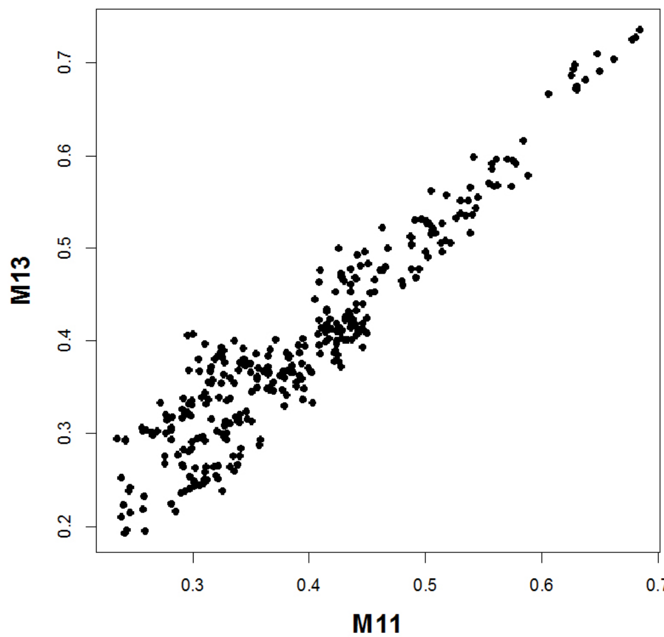
The plot is performed with the function plot.default of base graphics package and the linear regression with the function lm of base stats package. The function lillie.test of the package nortest (Gross, 2013) is used to perform the test of Normality Kolmogorov-Smirnov with Lilliefors'correction, the function dwtest of the package lmtest (Hothorn et al., 2013) to analyze the autocorrelation with the test and the Durbin-Watson statistic function bptest of the package lmtest (Hothorn et al., 2013) to perform the Breusch-Pagan test of homoscedasticity.

EXAMPLES

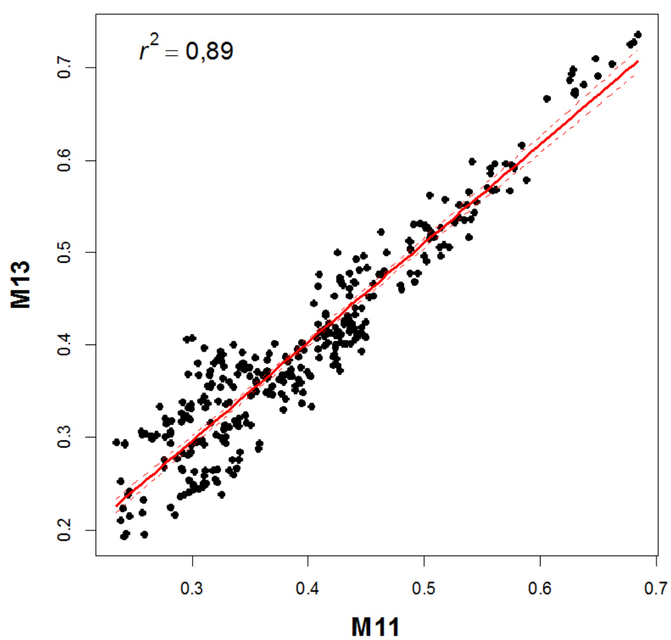
Example 1 The data are scores of a Principal Component Analysis (PCA) performed to physico-chemical parameters from lakes in Colombia. In this example, text labels are assigned to the points with the argument *textlabel="Lake"*.



Example 2 For the examples, morphometric data of several fish species of Characiforms, as the distance from the origin of the dorsal fin to the origin of the anal fin (M13), the length of the dorsal fin base (M12), body height (M11), etc., are used. For details see Guisande et al. (2010). It is shown the relationship between M11 and M13 for all species.



Example 3 A linear regression line is added to the example 2 with the argument *reg=TRUE*.



In the TXT file that generates the function, the regression model linear is shown, where the variable M11 is significant ($p < 0.001$, see *Pr(>|t|)*) and, therefore, the model as a whole was also significant ($p < 0.001$, see *p-value* at the end of the results).

The r^2 (see *Multiple R-squared*) shows that the M11 explains a 89.4% of the observed variance in the M13. The r^2 adjusted (see *Ajusted R-squared*) takes into account the size of the sample to determine the proportion above and, in this case, it is the same. The r^2 adjusted should be used to compare models with different numbers of observations or independent variables. The equation of the potential regression model must be expressed in this way: $M13 = -0.024 + 1.069 * M11$

```
[1] "LINEAR REGRESSION"

[[2]]

Call:
lm(formula = fo, data = datos2)

Residuals:
      Min        1Q    Median        3Q       Max 
-0.084235 -0.026201 -0.003362  0.027083  0.115736 

Coefficients:
             Estimate Std. Error t value Pr(>|t|)    
(Intercept) -0.024954   0.008189  -3.047  0.00249 ** 
M11          1.069505   0.020213  52.912  < 2e-16 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.03625 on 333 degrees of freedom
Multiple R-squared:  0.8937,	Adjusted R-squared:  0.8934 
F-statistic:  2800 on 1 and 333 DF,  p-value: < 2.2e-16
```

In the following table, the results of the test of Kolmogorov-Smirnov normality with Lilliefors' correction are shown, the test for autocorrelation of Durbin-Watson statistic and the Breusch-Pagan test of homoscedasticity.

Normality The residuals do not have a Normal distribution with p = 0.073. Although is not complied with the assumption of normality, this does not invalidate the model as it is very predictive with a r^2 very high. The problem resulting from these residuals are not Normal is that there can be no assurance that the degree of significance, probability value that shows the model, is the correct one.

Autocorrelation The requirement that there should be no autocorrelation is no longer met the test of Durbin-Watson statistic p < 0.001. This means that the value of r^2 of the 89.4% is not all due to the dependent variable, the M11, but it is also in part due to the own dependent variable that is auto explained and, therefore, it is not possible to know exactly how much is the variance explained by the independent variable. Anyway it is necessary to mention that the probability value of the test of Durbin-Watson statistic can be less than 0.05 easily when there are many data. The statistical DW, whose value is 0.39 in this example, is a better indicator of the autocorrelation when the number of data is very large. According to Durbin & Watson (1951), a DW less than 1 means a strong positive autocorrelation, a DW greater than 4 a strong negative autocorrelation, values between 1 and 3 a moderate autocorrelation, and a value close to 2 means that there is no autocorrelation. Therefore, it can be concluded that there is a strong positive autocorrelation in this example.

Homoscedasticity Finally, the requirement of homoscedasticity of the residuals is not satisfied, because the likelihood of the Breusch-Pagan test is p < 0.001. The fact of not fulfilled this requirement means that the model is not as predictive for the entire range of values of the dependent variable.

```
[1] "Normality"

[[4]]

     Lilliefors (Kolmogorov-Smirnov) normality test

data:  res
D = 0.0468, p-value = 0.07385


[[5]]
[1] "Autocorrelation"

[[6]]

     Durbin-Watson test

data:  reg
DW = 0.3973, p-value < 2.2e-16
alternative hypothesis: true autocorrelation is greater than 0


[[7]]
[1] "Homocedasticity"

[[8]]

     studentized Breusch-Pagan test

data:  reg
BP = 31.1577, df = 1, p-value = 2.379e-08
```

Value

A simple scatter plot with or without linear regression is obtained. Moreover, a TXT file is saved with the results of the regression model.

References

Durbin, J. & Watson G.S. (1951) Testing for serial correlation in least squares regression. *Biometrika*, **38**, 159-171.

Gross, J. (2013) Tests for Normality. R package version 1.0-2. Available at: https://CRAN.R-project.org/package=nortest.

Guisande, C., Manjarrés-Hernández, A., Pelayo-Villamil, P., Granado-Lorencio, C., Riveiro, I., Acuña, A., Prieto-Piraquive, E., Janeiro, E., Matías, J.M., Patti, C., Patti, B., Mazzola, S., Jiménez, S., Duque, V. & Salmerón, F. (2010) IPez: An expert system for the taxonomic identification of fishes based on machine learning techniques. *Fisheries Research*, 102, 240-247.

Hothorn, T. et al., (2013) Testing Linear Regression Models. R package version 0.9-33. Available at: https://CRAN.R-project.org/package=lmtest.

Examples

```
## Not run:

#Example 1

data(Z6)
```

```
F1(data=Z6, varY="Dimension2", varX="Dimension1", textlabel="Lake",
XLAB="Dimension 1", YLAB="Dimension 2",PLOT = c("xlim= c(-1,1)",
"xlab=xlab", "ylab=ylab", "col=COLOR", "pch=PCH"))

#Example 2

data(Z1)

F1(data=Z1, varY="M13", varX="M11")

#Example 3

F1(data=Z1, varY="M13", varX="M11", reg=TRUE)

## End(Not run)
```

F10 *2D PIE CHARTS*

Description

It performs 2D pie charts.

Usage

```
F10(data, var, labels, order=NULL, percut=NULL, per=FALSE, ResetPAR=TRUE,
PAR=NULL, PIE=NULL, COLOR=NULL, MTEXT= NULL, TEXT=NULL)
```

Arguments

`data`	Data file.
`var`	Variable with non-negative data.
`labels`	Variable with the categories for the slices or a vector with the names.
`order`	If it is NULL the categories are ordered as found in the variable *var*, if it is "increasing" are ordered from lesser to greater, if it is "decreasing" are ordered from greater to lesser, if it is "alhaAZ" are ordered from A to Z and if it is "alphaZA" from Z to A.
`percut`	It is possible to select a percentage threshold and only the categories above the threshold are shown.
`per`	If it is TRUE the percentage of each category is also shown.
`ResetPAR`	If it is FALSE, the default condition of the function PAR is not placed and maintained those defined by the user in previous graphics.
`PAR`	It accesses the function PAR that allows to modify many different aspects of the graph.
`PIE`	It allows to specify the characteristics of the function pie.
`COLOR`	Vector with the color of the categories.
`MTEXT`	It allows to add text on the margins of the graph.
`TEXT`	It allows to add text in any area of the inner part of the graph.

Details

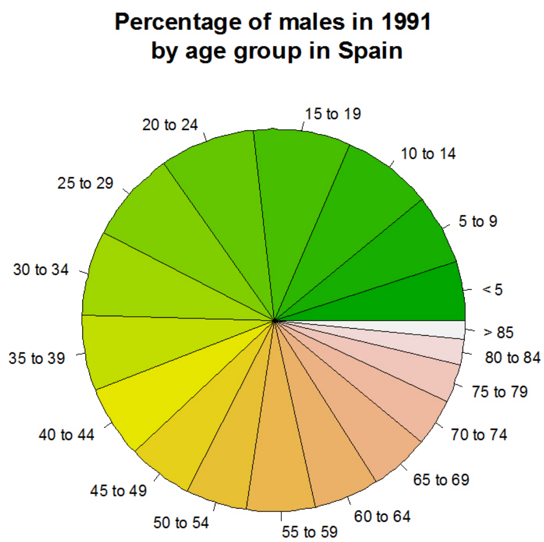
FUNCTIONS

The plot is performed with the function pie of base graphics package. For further details see the help of the function pie and/or Guisande & Vammonde (2012).

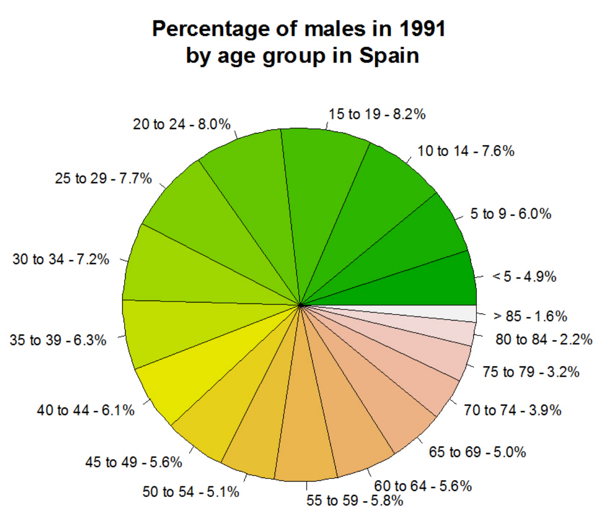
EXAMPLES

The data are the human population density by sex and age group in Spain for the years 1900 and 1991. Data were obtained from the Spanish Statistical Office `http://www.ine.es`.

Example 1. The percentage of males in 1991 by age group is shown.



Example 2. As in the example 1 but showing the percentages of each category in the labels with the argument *per=TRUE*.



Value

A 2D pie charts is obtained.

References

Guisande, C. & Vaamonde, A. (2012) *Gráficos estadísticos y mapas con R*. Ediciones Díaz de Santos, Madrid, 367 pp.

Examples

```
## Not run:

data(Z7)

#Example 1

F10(data=Z7, var="M.1991", labels="Age",
MTEXT = c("text = 'Percentage of males in 1991\n by age group in Spain'",
"font = 2", "cex=1.5"))

#Example 2

F10(data=Z7, var="M.1991", labels="Age",
MTEXT = c("text = 'Percentage of males in 1991\n by age group in Spain'",
"font = 2", "cex=1.5"), per=TRUE)

## End(Not run)
```

F11 *FAN PLOTS*

Description

It performs fan plots.

Usage

```
F11(data, var, labels, percut=NULL, per=FALSE, ResetPAR=TRUE, PAR=NULL,
FAN=NULL, COLOR=NULL, MTEXT= NULL, TEXT=NULL)
```

Arguments

`data`	Data file.
`var`	Variable with non-negative data.
`labels`	Variable with the categories for the slices or a vector with the names for the slices.
`percut`	It is possible to select a percentage threshold and only the categories above the threshold are shown.

`per`	If it is TRUE the percentage of each category is also shown.
`ResetPAR`	If it is FALSE, the default condition of the function PAR is not placed and maintained those defined by the user in previous graphics.
`PAR`	It accesses the function PAR that allows to modify many different aspects of the graph.
`FAN`	It allows to specify the characteristics of the function fan.plot.
`COLOR`	Vector with the color of the categories.
`MTEXT`	It allows to add text on the margins of the graph.
`TEXT`	It allows to add text in any area of the inner part of the graph.

Details

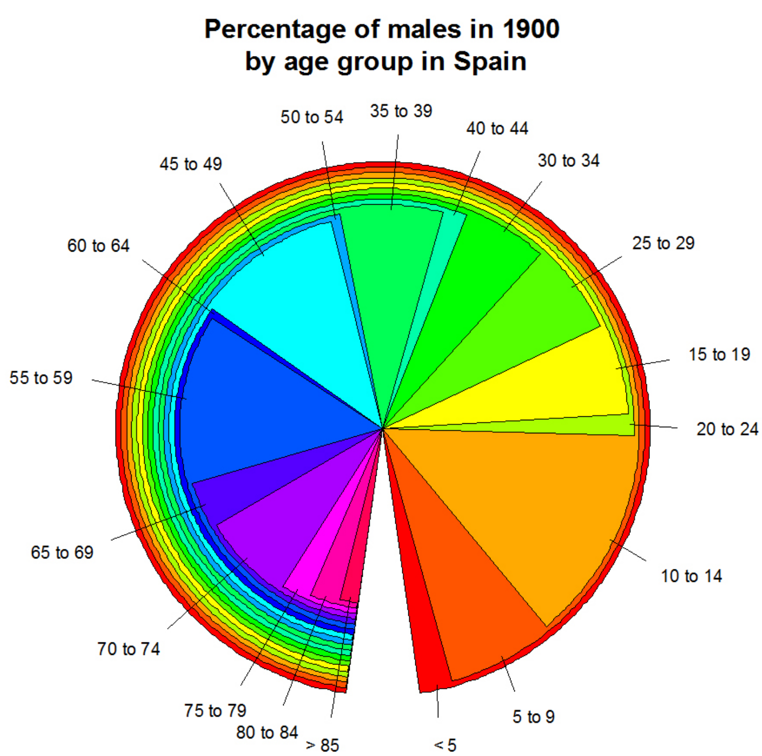
FUNCTIONS

The plot is performed with the function fan.plot of the package plotrix (Lemon et al., 2015). For further details see the help of the function fan.plot and/or Guisande & Vammonde (2012).

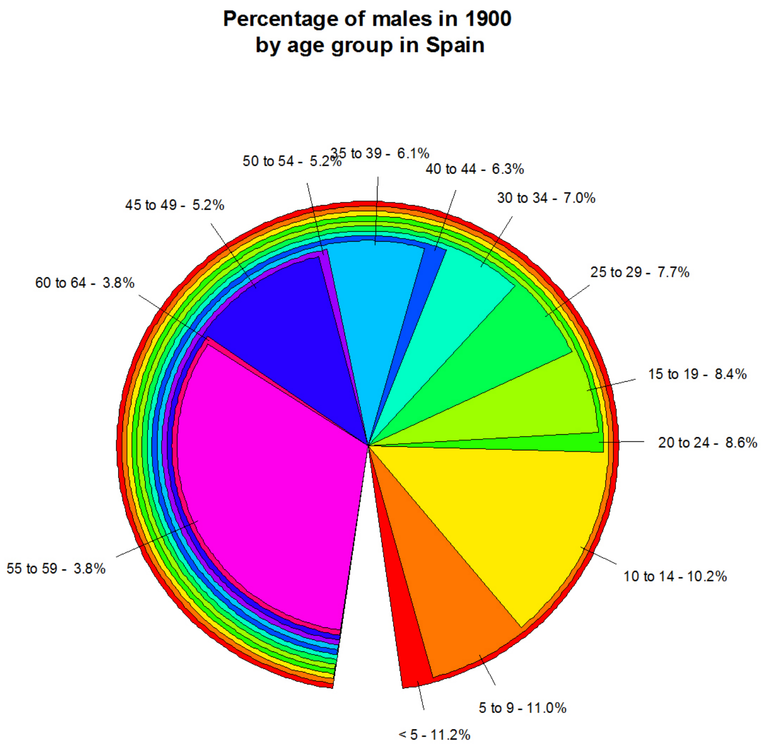
EXAMPLES

The data are the human population density by sex and age group in Spain for the years 1900 and 1991. Data were obtained from the Spanish Statistical Office `http://www.ine.es`.

Example 1. The percentage of males by age group in 1900 is shown.



Example 2. As in the example 1 but showing the percentages of each category in the labels with the argument *per=TRUE* and only the categories with a percentage above 3% with the argument *percut=3*.



Value

A fan plot is obtained.

References

Guisande, C. & Vaamonde, A. (2012) *Gráficos estadísticos y mapas con R*. Ediciones Díaz de Santos, Madrid, 367 pp.

Lemon, J., Bolker, B., Oom, S., Klein, E., Rowlingson, B., Wickham, H., Tyagi, A., Eterradossi, O., Grothendieck, G., Toews, M., Kane, J., Turner, R., Witthoft, C., Stander, J., Petzoldt, T., Duursma, R., Biancotto, E., Levy, O., Dutang, C., Solymos, P., Engelmann, R., Hecker, M., Steinbeck, F., Borchers, H., Singmann, H., Toal, T. & Ogle, D. (2015) Various plotting functions. R package version 3.5-11. Available at: https://CRAN.R-project.org/package=plotrix.

Examples

```
## Not run:

data(Z7)

#Example 1
```

```
F11(data=Z7, var="M.1900", labels="Age",
MTEXT = c("text = 'Percentage of males in 1900\n by age group in Spain'",
"font = 2", "cex=1.5"))

#Example 2

F11(data=Z7, var="M.1900", labels="Age",
MTEXT = c("text = 'Percentage of males in 1900\n by age group in Spain'",
"font = 2", "cex=1.5"), percut=3, per=TRUE)

## End(Not run)
```

F12 *3D PIE CHARTS*

Description

It performs 3D pie charts.

Usage

```
F12(data, var, labels, percut=NULL, per=FALSE, explode=0.05, ResetPAR=TRUE,
PAR=NULL, PIE3D=NULL, COLOR=NULL, MTEXT= NULL, TEXT=NULL)
```

Arguments

`data`	Data file.
`var`	Variable with non-negative data.
`labels`	Variable with the categories for the slices or a vector with the names for the slices.
`percut`	It is possible to select a percentage threshold and only the categories above the threshold are shown.
`per`	If it is TRUE the percentage of each category is also shown.
`explode`	Gap among slices.
`ResetPAR`	If it is FALSE, the default condition of the function PAR is not placed and maintained those defined by the user in previous graphics.
`PAR`	It accesses the function PAR that allows to modify many different aspects of the graph.
`PIE3D`	It allows to specify the characteristics of the function pie3D.
`COLOR`	Vector with the color of the categories.
`MTEXT`	It allows to add text on the margins of the graph.
`TEXT`	It allows to add text in any area of the inner part of the graph.

Details

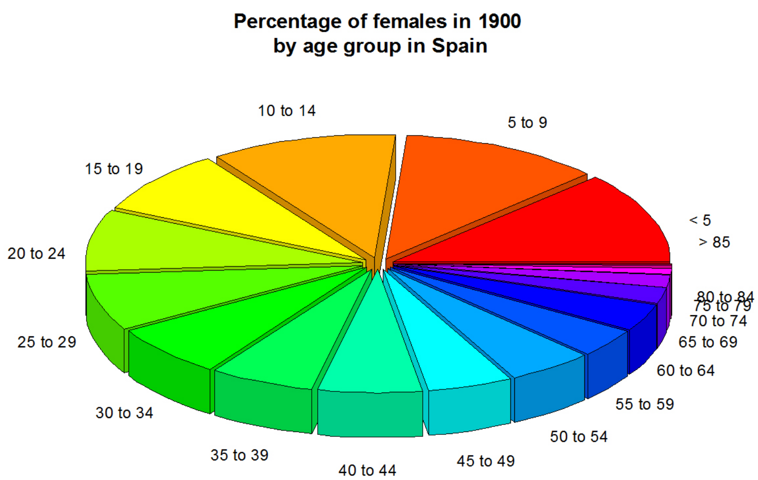
FUNCTIONS

The plot is performed with the function pie3D of the package plotrix (Lemon et al., 2015). For further details see the help of the function pie3D and/or Guisande & Vammonde (2012).

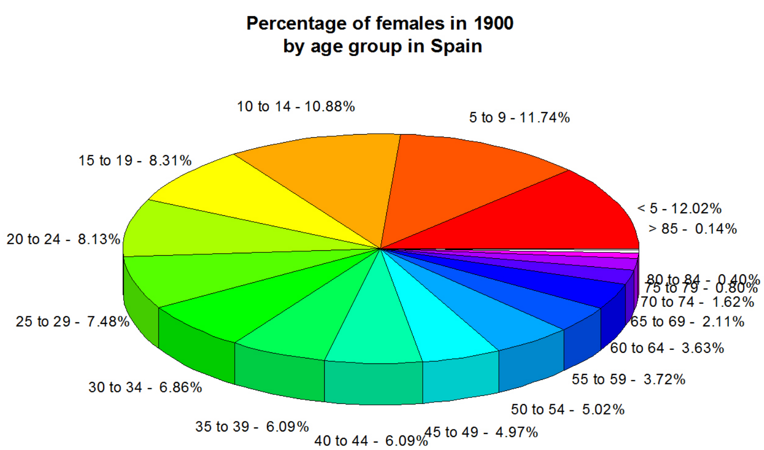
EXAMPLES

The data are the human population density by sex and age group in Spain for the years 1900 and 1991. Data were obtained from the Spanish Statistical Office `http://www.ine.es`.

Example 1. The percentage of females by age group in 1900 is shown.



Example 2. As in the example 1 but without gap among slices with the argument *explode=0* and showing the percentages of each category in the labels with the argument *per=TRUE*.



Value

A 3D pie chart is obtained.

References

Guisande, C. & Vaamonde, A. (2012) *Gráficos estadísticos y mapas con R*. Ediciones Díaz de Santos, Madrid, 367 pp.

Lemon, J., Bolker, B., Oom, S., Klein, E., Rowlingson, B., Wickham, H., Tyagi, A., Eterradossi, O., Grothendieck, G., Toews, M., Kane, J., Turner, R., Witthoft, C., Stander, J., Petzoldt, T., Duursma, R., Biancotto, E., Levy, O., Dutang, C., Solymos, P., Engelmann, R., Hecker, M., Steinbeck, F., Borchers, H., Singmann, H., Toal, T. & Ogle, D. (2015) Various plotting functions. R package version 3.5-11. Available at: https://CRAN.R-project.org/package=plotrix.

Examples

```
## Not run:

data(Z7)

#Example 1

F12(data=Z7, var="F.1900", labels="Age",
MTEXT=c("text = 'Percentage of females in 1900\n by age group in Spain'",
"font = 2", "cex=1.5", "line=-5"))

#Example 2

F12(data=Z7, var="F.1900", labels="Age", explode=0,
MTEXT=c("text = 'Percentage of females in 1900\n by age group in Spain'",
"font = 2", "cex=1.5", "line=-5"), per=TRUE)

## End(Not run)
```

F13 *MULTIPLE SCATTER PLOT FOR VARIABLE X QUANTITATIVE*

Description

It performs a multiple scatter plot with or without text labels and a regression model for each category.

Usage

```
F13(data, varY,  varX, group, textlabel=NULL, label=NULL, reg=FALSE,
model="Linear", outliers=FALSE, quant1=0.05, quant2 = 0.95,  ResetPAR=TRUE,
PAR=NULL, XLAB=NULL, YLAB=NULL, COLOR=NULL, COLORR=NULL, PCH=NULL, CEX=1,
lty=NULL, lwd=2.5, PLOT=NULL, LEGEND=NULL, AXIS=NULL, MTEXT=NULL,
TEXT=NULL, dec=",", file="Output.txt")
```

Arguments

- `data` Data file.
- `varY` Dependent variable.
- `varX` Quantitative independent variable.
- `group` Variable with the categories to be grouped.
- `textlabel` Variable with the text labels.
- `label` It allows to specify the characteristics of the text labels with the function text.
- `reg` If TRUE a regression model is performed.
- `model` One regression model can be selected: "Linear" , "Log", "S-curve", "Power", "Exp", "Quadratic", "Cubic", "Inverse". It is not considered the model in those cases in which there is the logarithm that apply to any of the variables, if any value of the variable, which applies the logarithm, is zero or negative. The inverse model is not calculated if any value of the independent variable is zero.
- `outliers` If it is TRUE, the outliers are removed using the selected regression model.
- `quant1` Quantile of the lower end to the elimination of outliers.
- `quant2` Quantile of the upper end to the elimination of outliers.
- `ResetPAR` If it is FALSE, the default condition of the function PAR is not placed and maintained those defined by the user in previous graphics.
- `PAR` It accesses the function PAR that allows to modify many different aspects of the graph.
- `XLAB` Legend of the X axis.
- `YLAB` Legend of the Y axis.
- `COLOR` Color of the symbols. It must be as many as different categories of the variable *group*.
- `COLORR` Color of the line of the regression model. It must be as many as different categories of the variable *group*.
- `PCH` Graphic symbol (see the description of the same argument in the function F1). It must be as many as different categories of the variable *group*.
- `CEX` Size of the symbols.
- `lty` Type of the regression line (see the description of the same argument in the function F1).
- `lwd` Line width of the regression line relative to the default (default=1), so 2 is twice as wide.
- `PLOT` It allows to specify the characteristics of the function plot.default.
- `LEGEND` It allows to modify the legend of the graph.
- `AXIS` It allows to add axes to the graph.
- `MTEXT` It allows to add text on the margins of the graph.
- `TEXT` It allows to add text in any area of the inner part of the graph.
- `dec` It defines if the comma "," is used as decimal separator or the dot ".".
- `file` TXT FILE. If the argument *reg=TRUE* a TXT file is saved with the information of the regression.

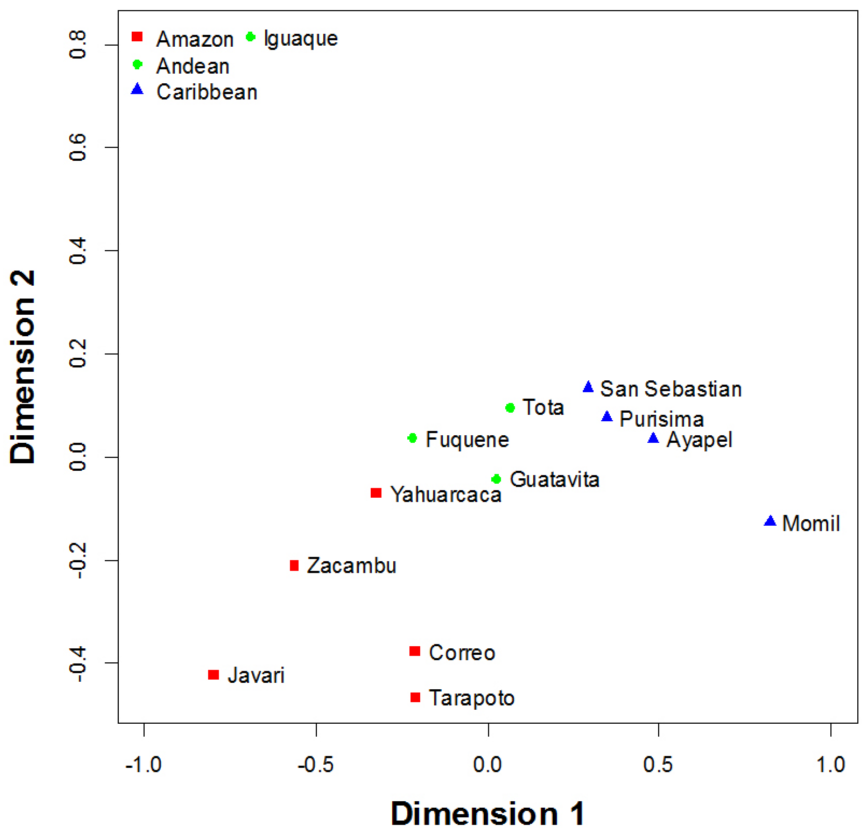
Details

FUNCTIONS

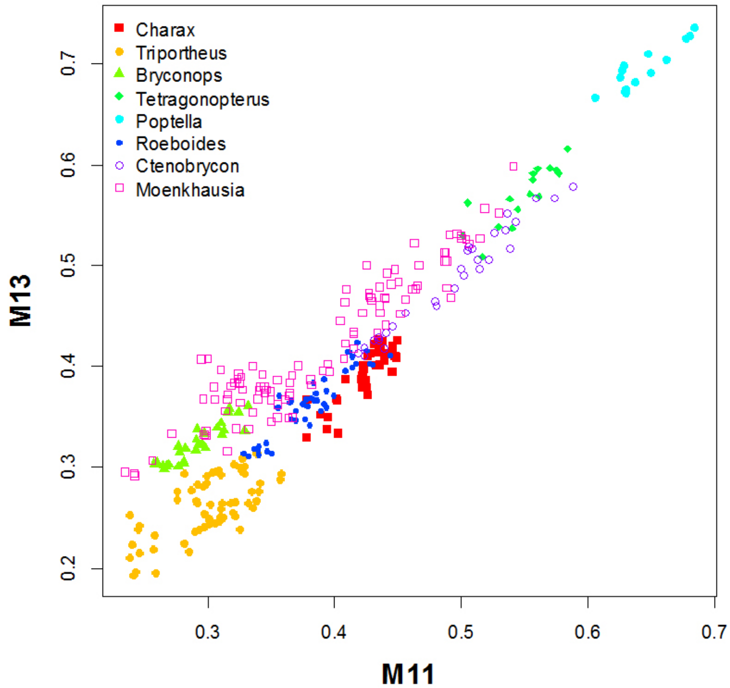
The plot is performed with the function plot.default of base graphics package and the linear regression with the function lm of base stats package. The function lillie.test of the package nortest (Gross, 2013) is used to perform the test of Normality Kolmogorov-Smirnov with Lilliefors'correction, the function dwtest of the package lmtest (Hothorn et al., 2013) to analyze the autocorrelation with the test and the Durbin-Watson statistic function bptest of the package lmtest (Hothorn et al., 2013) to perform the Breusch-Pagan test of homoscedasticity.

EXAMPLES

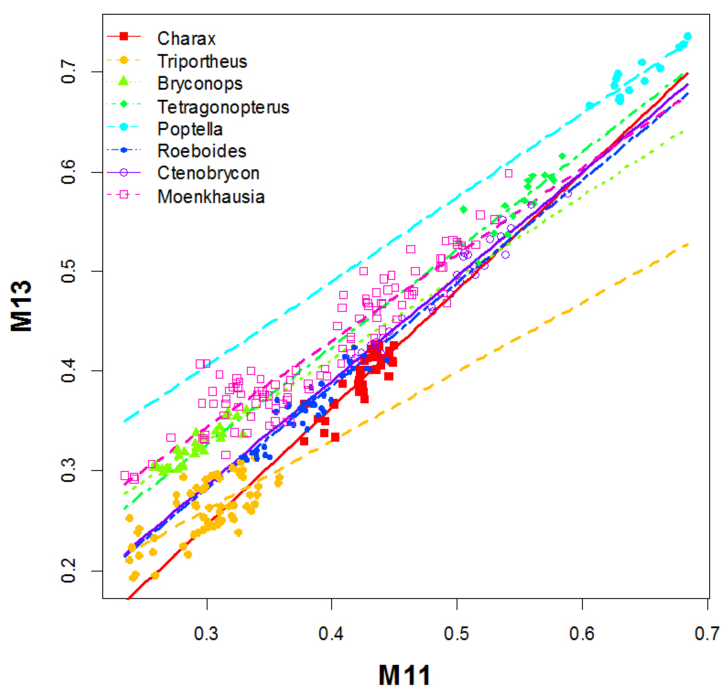
Example 1 The data are scores of a Principal Component Analysis (PCA) performed to physicochemical parameters from lakes in Colombia. In this example, text labels are assigned to the points with the argument *textlabel="Lake"*, and the different regions are identified with the argument *group="Region"*.



Example 2 For the examples, morphometric data of several fish species of Characiforms, as the distance from the origin of the dorsal fin to the origin of the anal fin (M13), the length of the dorsal fin base (M12), body height (M11), etc., are used. For details see Guisande et al. (2010). It is shown the relationship between M11 and M13 for each genera.



Example 3 A linear regression line is added to the example 2 with the argument *reg=TRUE*.



In the TXT file that generates the function, the regression model of each genera is shown. For the explanation of the regression models, normality, autocorrelation and homoscedasticity see the *details* section of the function F1.

Value

A multiple scatter plot with or without text labels and regression models for different categories is obtained.

References

Durbin, J. & Watson G.S. (1951) Testing for serial correlation in least squares regression. *Biometrika*, **38**, 159-171.

Gross, J. (2013) Tests for Normality. R package version 1.0-2. Available at: https://CRAN.R-project.org/package=nortest.

Guisande, C., Manjarrés-Hernández, A., Pelayo-Villamil, P., Granado-Lorencio, C., Riveiro, I., Acuña, A., Prieto-Piraquive, E., Janeiro, E., Matías, J.M., Patti, C., Patti, B., Mazzola, S., Jiménez, S., Duque, V. & Salmerón, F. (2010) IPez: An expert system for the taxonomic identification of fishes based on machine learning techniques. *Fisheries Research*, 102, 240-247.

Hothorn, T. et al., (2013) Testing Linear Regression Models. R package version 0.9-33. Available at: https://CRAN.R-project.org/package=lmtest.

Examples

```
## Not run:

#Example 1

data(Z6)

F13(data=Z6 , varY="Dimension2", varX="Dimension1", group="Region",
textlabel="Lake", XLAB="Dimension 1", YLAB="Dimension 2", PLOT=c("xlim=c(-1,1)",
"xlab=xlab", "ylab=ylab", "col=COLOR", "pch=PCH"))

#Example 2

data(Z1)

F13(data=Z1, varY="M13", varX="M11", group="Genus")

#Example 3

F13(data=Z1, varY="M13", varX="M11", group="Genus", reg=TRUE)

## End(Not run)
```

F14 *MULTIPLE MEAN WITH ERROR BARS SCATTER PLOT FOR VARIABLE X QUANTITATIVE WITH TEXT LABELS AND REGRESSION*

Description

It performs a multiple mean with error bars scatter plot for variable X quantitative with text labels and a regression model.

Usage

```
F14(data, varY, varX, Factor, group, method="mean", dev="sd", barY=TRUE,
barX=FALSE, textlabel=FALSE, label=NULL, reg=FALSE, model="Linear",
outliers=FALSE, quant1=0.05, quant2 = 0.95, ResetPAR=TRUE, PAR=NULL, XLAB=NULL,
YLAB=NULL, XLIM=NULL, YLIM=NULL,  COLOR=NULL, COLORI="black", COLORR=NULL,
PCH=NULL, CEX=1, lty=NULL, lwd=2.5, PLOT=NULL, LEGEND=NULL, AXIS=NULL,
MTEXT= NULL, TEXT=NULL, file1="Output.txt", file2="Average and error bars.csv",
na="NA", dec=",", row.names=FALSE)
```

Arguments

`data`	Data file.
`varY`	Dependent variable.
`varX`	Quantitative independent variable.
`Factor`	Variable for the estimation of the average and error bars for each category of the variable. It is not possible to include variables with any of the categories with a single data, so if necessary several data for each category.
`group`	Variable with the categories to be grouped.
`method`	The average of each category of the grouped variable *Factor* is estimated with the "mean" or the "median".
`dev`	The error bars may be estimated using the standard deviation ("sd") or the standard error ("se").
`barY`	If it is TRUE the bar error of the variable Y is depicted.
`barX`	If it is TRUE the bar error of the variable X is depicted.
`textlabel`	If TRUE the text labels of the categories of the variable *Factor* are added to the plot.
`label`	It allows to specify the characteristics of the text labels with the function text.
`reg`	If it is TRUE a regression model is performed for each set of data defined with the argument *group*.
`model`	One regression model can be selected: "Linear" , "Log", "S-curve", "Power", "Exp", "Quadratic", "Cubic", "Inverse". It is not considered the model in those cases in which there is the logarithm that apply to any of the variables, if any value of the variable, which applies the logarithm, is zero or negative. The inverse model is not calculated if any value of the independent variable is zero.

`outliers`	If it is TRUE, the outliers are removed using the selected regression model.
`quant1`	Quantile of the lower end to the elimination of outliers.
`quant2`	Quantile of the upper end to the elimination of outliers.
`ResetPAR`	If it is FALSE, the default condition of the function PAR is not placed and maintained those defined by the user in previous graphics.
`PAR`	It accesses the function PAR that allows to modify many different aspects of the graph.
`XLAB`	Legend of the X axis.
`YLAB`	Legend of the Y axis.
`XLIM`	Vector with the limits of the X axis.
`YLIM`	Vector with the limits of the Y axis.
`COLOR`	Color of the symbols. It must be as many as different categories of the variable *group*.
`COLORI`	Color of the error bars.
`COLORR`	Color of the line of the regression model. It must be as many as different categories of the variable *group*.
`PCH`	Graphic symbol (see the description of the same argument in the function F1). It must be as many as different categories of the variable *group*.
`CEX`	Size of the symbols.
`lty`	Type of the regression line (see the description of the same argument in the function F1).
`lwd`	Line width of the regression line relative to the default (default=1), so 2 is twice as wide.
`PLOT`	It allows to specify the characteristics of the function plot.default.
`LEGEND`	It allows to modify the legend of the graph.
`AXIS`	It allows to add axes to the graph.
`MTEXT`	It allows to add text on the margins of the graph.
`TEXT`	It allows to add text in any area of the inner part of the graph.
`file1`	TXT FILE. If the argument *reg=TRUE* a TXT file is saved with the information of the regression.
`file2`	CSV FILE. File name with the mean, median, standard error and standard deviation for each category of the variable *Factor*
`na`	CSV FILES. Text that is used in the cells without data.
`dec`	CSV FILES. It defines if the comma "," is used as decimal separator or the dot ".".
`row.names`	CSV FILES. Logical value that defines if identifiers are put in rows or a vector with a text for each of the rows.

Details

See the equations of all regression models in the section *details* of the function XI1 of the package StatR.

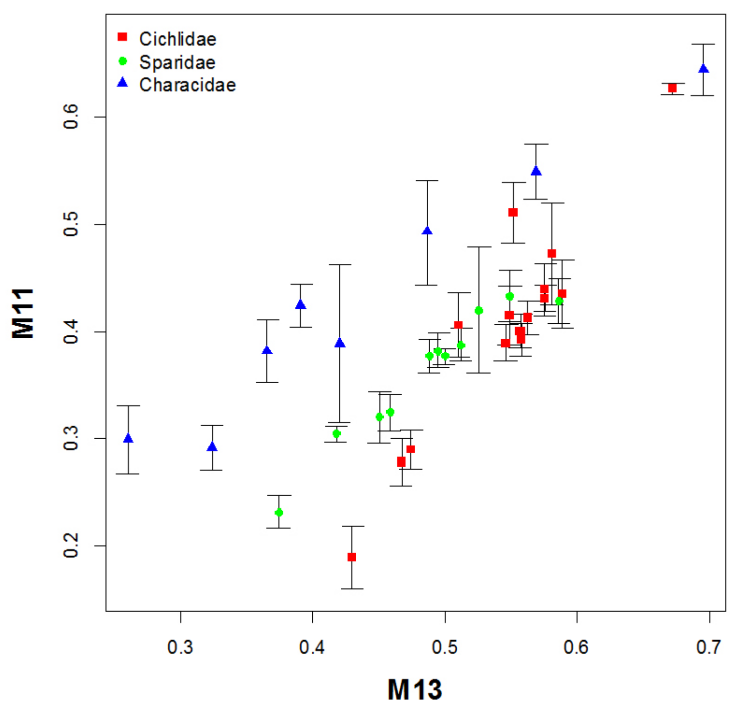
FUNCTIONS

The plot is performed with the function plot.default of base graphics package and the linear regression with the function lm of base stats package. The function lillie.test of the package nortest (Gross, 2013) is used to perform the test of Normality Kolmogorov-Smirnov with Lilliefors'correction, the function dwtest of the package lmtest (Hothorn et al., 2013) to analyze the autocorrelation with the test and the Durbin-Watson statistic function bptest of the package lmtest (Hothorn et al., 2013) to perform the Breusch-Pagan test of homoscedasticity.

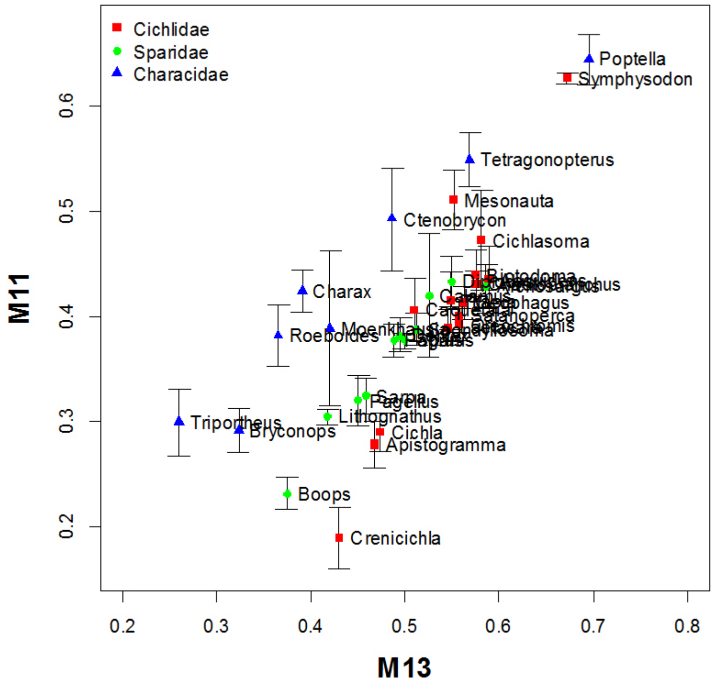
EXAMPLES

For the examples, morphometric data of three families of freshwater fishes, as the distance from the origin of the dorsal fin to the origin of the anal fin (M13), the length of the dorsal fin base (M12), body height (M11), etc., are used. For details see Guisande et al. (2010). It is shown the relationship between M11 and M13 for all genera grouped by families.

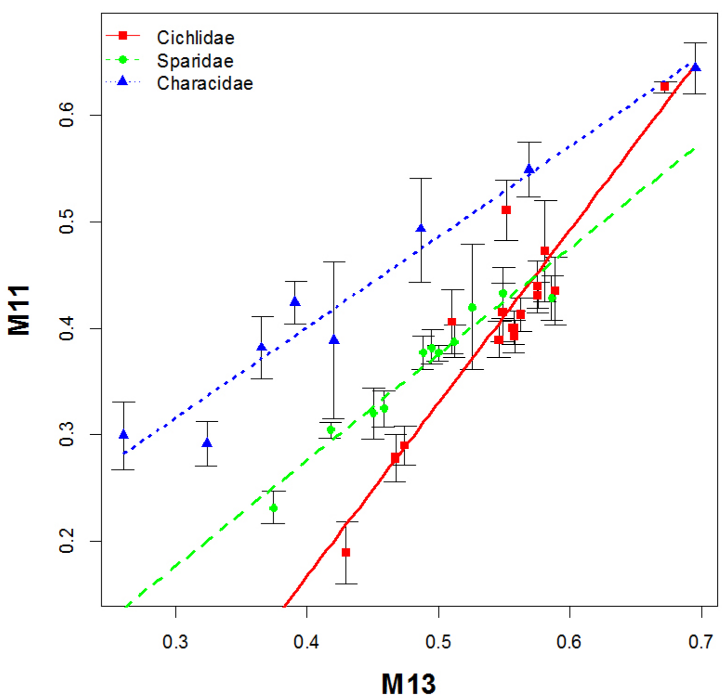
Example 1. Relationship between the mean values of M13 and M11 for each genera with the standard deviation of the M11, and grouped by families.



Example 2. As in the example 1 but adding the text labels of the genera with the argument *textlabel=TRUE.*



Example 3. As in the example 1 but a linear regression line is added for each family with the argument *reg=TRUE*.



In the TXT file that generates the function, the regression model of each family is shown. For the explanation of the regression models, normality, autocorrelation and homoscedasticity see the *details* section of the function F1.

Value

A multiple scatter plot with mean error bars, with or without linear regression and with or without text labels is obtained. A CVS file with the mean, median, standard error and standard deviation for each category of the variable *Factor* is also obtained.

References

Durbin, J. & Watson G.S. (1951) Testing for serial correlation in least squares regression. *Biometrika*, **38**, 159-171.

Gross, J. (2013) Tests for Normality. R package version 1.0-2. Available at: `https://CRAN.R-project.org/package=nortest`.

Guisande, C., Manjarrés-Hernández, A., Pelayo-Villamil, P., Granado-Lorencio, C., Riveiro, I., Acuña, A., Prieto-Piraquive, E., Janeiro, E., Matías, J.M., Patti, C., Patti, B., Mazzola, S., Jiménez, S., Duque, V. & Salmerón, F. (2010) IPez: An expert system for the taxonomic identification of fishes based on machine learning techniques. *Fisheries Research*, 102, 240-247.

Hothorn, T. et al., (2013) Testing Linear Regression Models R package version 0.9-33. Available at: `https://CRAN.R-project.org/package=lmtest`.

Examples

```
## Not run:

#Example 1

data(Z8)

F14(data=Z8, varY="M11", varX="M13", Factor="Genus", group="Family")

#Example 2

F14(data=Z8, varY="M11", varX="M13", Factor="Genus", group="Family",
textlabel=TRUE, XLIM=c(0.2,0.8))

#Example 3

F14(data=Z8, varY="M11", varX="M13", Factor="Genus", group="Family",
reg=TRUE)


## End(Not run)
```

F15 *MULTIPLE DOT OR MEAN WITH ERROR BARS SCATTER PLOTS FOR VARIABLE X QUALITATIVE*

Description

It performs a multiple dot or mean with error bars scatter plots for variable X qualitative.

Usage

```
F15(data, varY, FactorX, group, method="mean", dev="sd", ResetPAR=TRUE,
PAR=NULL, order=NULL, OrderCat=NULL, LabelCat=NULL, XLAB=NULL, YLAB=NULL,
XLIM=NULL, YLIM=NULL, COLOR=NULL, COLORI="black", PCH=NULL, CEX=1, LEGEND=NULL,
AXIS=NULL,MTEXT= NULL, TEXT=NULL)
```

Arguments

`data`	Data file.
`varY`	Dependent variable.
`FactorX`	Qualitative independent variable.
`group`	Variable with the categories to be grouped.
`method`	If it is not NULL, the average of each category of the independent variable *FactorX* is estimated with the "mean" or the "median".
`dev`	If the argument *method* is not NULL, the error bars may be estimated using the standard deviation ("sd") or the standard error ("se").
`ResetPAR`	If it is FALSE, the default condition of the function PAR is not placed and maintained those defined by the user in previous graphics.
`PAR`	It accesses the function PAR that allows to modify many different aspects of the graph.
`order`	If it is NULL the categories are ordered as found in the variable *FactorX*, if it is "increasing" are ordered from lesser to greater median or mean according to the method selected in the argument *method*, if it is "decreasing" are ordered from greater to lesser median or mean, if it is "alhaAZ" are ordered from A to Z and if it is "alphaZA" from Z to A.
`OrderCat`	It allows to specify a vector with the order in which the categories are shown. If this argument is specified, the argument *order* is not taken into account.
`LabelCat`	It allows to specify a vector with the names of the categories.
`XLAB`	Legend of the X axis.
`YLAB`	Legend of the Y axis.
`XLIM`	Vector with the limits of the X axis.
`YLIM`	Vector with the limits of the Y axis.
`COLOR`	Color of the symbols. It must be as many as different categories of the variable *group*.

`COLORI`	Color of the error bars.
`PCH`	Graphic symbol (see the description of the same argument in the function F1). It must be as many as different categories of the variable *group*.
`CEX`	Size of the symbols.
`LEGEND`	It allows to modify the legend of the graph.
`AXIS`	It allows to add axes to the graph.
`MTEXT`	It allows to add text on the margins of the graph.
`TEXT`	It allows to add text in any area of the inner part of the graph.

Details

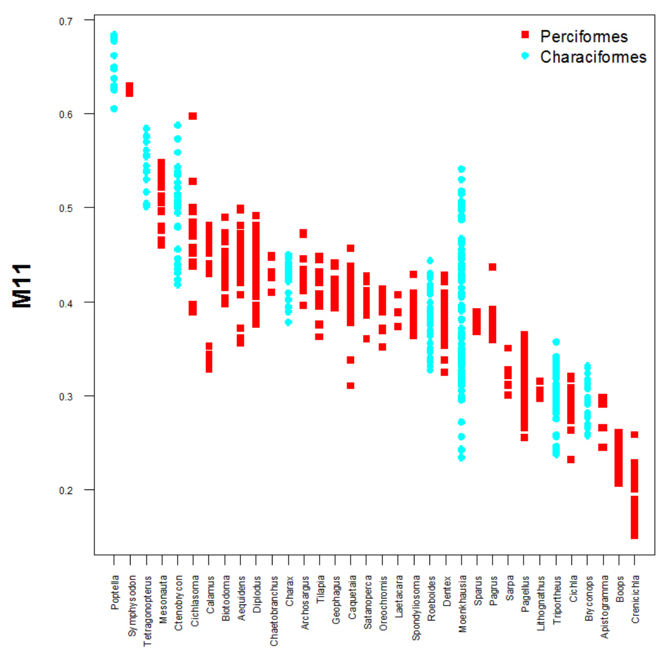
FUNCTIONS

The plot is performed with the functions boxplot, points and arrows of base graphics package. For further details see Guisande & Vammonde (2012).

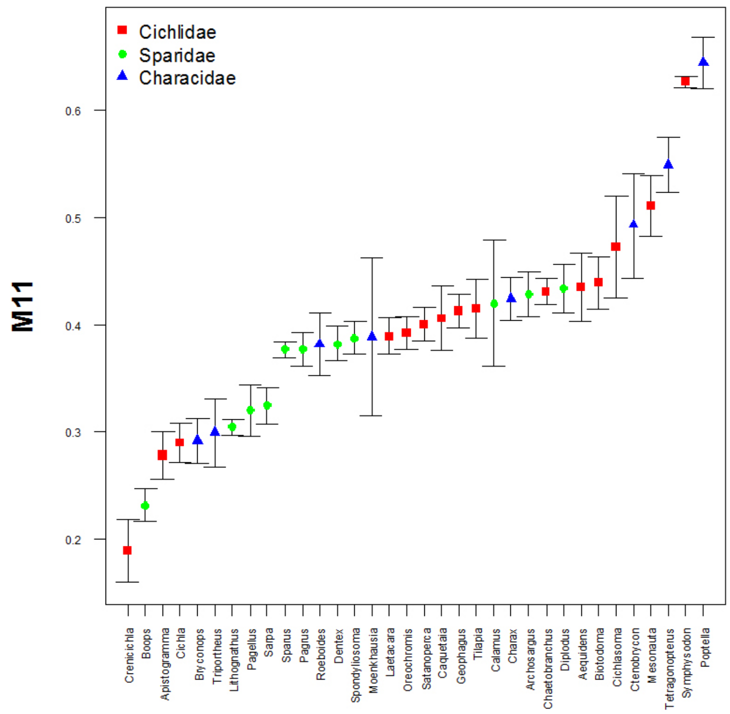
EXAMPLES

For the examples, morphometric data of three families of freshwater fishes, as the distance from the origin of the dorsal fin to the origin of the anal fin (M13), the length of the dorsal fin base (M12), body height (M11), etc., are used. For details see Guisande et al. (2010).

Example 1 A dot plot is depicted with the argument *method=NULL* of the variable M11 for all genera of fishes grouped by families. The different genera are ordered from greater to lesser with the argument *order="increasing"*. The legend of the axis X is removed with the argument *XLAB=""*. In the argument *PAR* the argument *las=2* means that the legend of the axis are perpendicular to the axis and the size of the axis labels are modified with the argument *cex.axis=0.62*.



Example 2 The mean and the standard deviation of the variable M11 is obtained for each genus.



Value

A multiple dot or mean scatter plots are obtained.

References

Guisande, C., Manjarrés-Hernández, A., Pelayo-Villamil, P., Granado-Lorencio, C., Riveiro, I., Acuña, A., Prieto-Piraquive, E., Janeiro, E., Matías, J.M., Patti, C., Patti, B., Mazzola, S., Jiménez, S., Duque, V. & Salmerón, F. (2010) IPez: An expert system for the taxonomic identification of fishes based on machine learning techniques. *Fisheries Research*, 102, 240-247.

Guisande, C. & Vaamonde, A. (2012) *Gráficos estadísticos y mapas con R*. Ediciones Díaz de Santos, Madrid, 367 pp.

Examples

```
## Not run:

#Example 1

data(Z8)

F15(data=Z8, varY="M11", FactorX="Genus", group="Order", method=NULL,
PAR = c("cex.lab = 1.5" , "font.lab = 2" , "las = 2" , "mar = c(5,5,3,2)",
"cex.axis=0.62"), order="decreasing", XLAB="", LEGEND = c("x = 'topright'",
"legend = dati" , "col = COLOR" , "pch = PCH" , "bty = 'n'"))
```

```
#Example 2

F15(data=Z8, varY="M11", FactorX="Genus", group="Family", PAR = c("cex.lab = 1.5",
"font.lab = 2", "las = 2", "mar = c(5,5,3,2)", "cex.axis=0.62"), XLAB="",
order="increasing")

## End(Not run)
```

F16 *MULTIPLE DOT OR MEAN WITH ERROR BARS SCATTER PLOT FOR VARIABLE X QUALITATIVE WITH TEXT LABELS*

Description

It performs a multiple dot and mean with error bars scatter plots for variable X qualitative wiith text labels.

Usage

```
F16(data, varY, FactorX, group, label=NULL, method="mean", dev="sd",
ResetPAR=TRUE, PAR=NULL, order=NULL, OrderCat=NULL, LabelCat=NULL,
XLAB=NULL, YLAB=NULL, XLIM=NULL, YLIM=NULL, COLOR=NULL, COLORI="black",
PCH=NULL, CEX=1, LEGEND=NULL, AXIS=NULL,MTEXT= NULL, TEXT=NULL)
```

Arguments

`data`	Data file.
`varY`	Dependent variable.
`FactorX`	Qualitative independent variable.
`group`	Variable with the categories to be grouped.
`label`	It allows to specify the characteristics of the text labels with the function text.
`method`	If it is not NULL, the average of each category of the independent variable *FactorX* is estimated with the "mean" or the "median".
`dev`	If the argument *method* is not NULL, the error bars may be estimated using the standard deviation ("sd") or the standard error ("se").
`ResetPAR`	If it is FALSE, the default condition of the function PAR is not placed and maintained those defined by the user in previous graphics.
`PAR`	It accesses the function PAR that allows to modify many different aspects of the graph.
`order`	If it is NULL the categories are ordered as found in the variable *FactorX*, if it is "increasing" are ordered from lesser to greater median or mean according to the method selected in the argument *method*, if it is "decreasing" are ordered from greater to lesser median or mean, if it is "alhaAZ" are ordered from A to Z and if it is "alphaZA" from Z to A.

OrderCat	It allows to specify a vector with the order in which the categories are shown. If this argument is specified, the argument *order* is not taken into account.
LabelCat	It allows to specify a vector with the names of the categories.
XLAB	Legend of the X axis.
YLAB	Legend of the Y axis.
XLIM	Vector with the limits of the X axis.
YLIM	Vector with the limits of the Y axis.
COLOR	Color of the symbols. It must be as many as different categories of the variable *group*.
COLORI	Color of the error bars.
PCH	Graphic symbol (see the description of the same argument in the function F1). It must be as many as different categories of the variable *group*.
CEX	Size of the symbols.
LEGEND	It allows to modify the legend of the graph.
AXIS	It allows to add axes to the graph.
MTEXT	It allows to add text on the margins of the graph.
TEXT	It allows to add text in any area of the inner part of the graph.

Details

FUNCTIONS

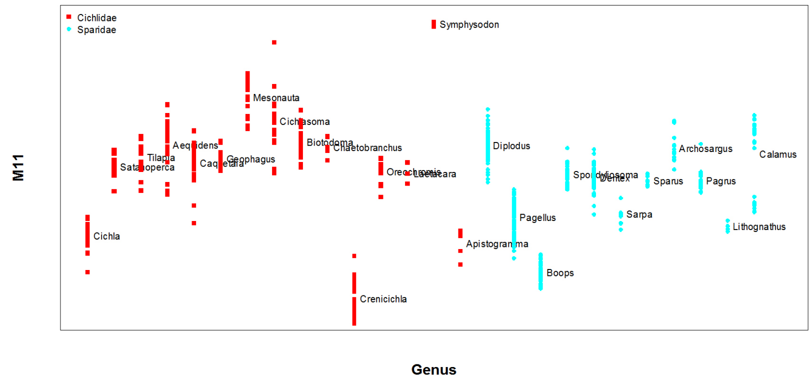
The plot is performed with the functions boxplot, points and arrows of base graphics package. For further details see Guisande & Vammonde (2012).

EXAMPLES

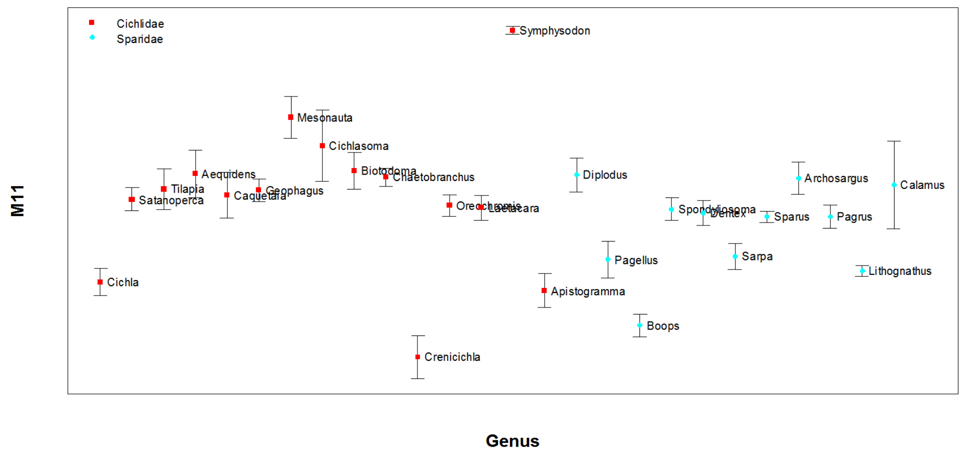
For the examples, morphometric data of three families of freshwater fishes, as the distance from the origin of the dorsal fin to the origin of the anal fin (M13), the length of the dorsal fin base (M12), body height (M11), etc., are used. For details see Guisande et al. (2010).

A filter is included to select only the Perciformes.

Example 1 A dot plot is depicted with the argument *method=NULL* of the variable M11 for all genera of Perciformes grouped by families.



Example 2 The mean and the standard deviation of the variable M11 is obtained for each genus.



Value

A multiple dot or mean scatter plots with text labels are obtained.

References

Guisande, C., Manjarrés-Hernández, A., Pelayo-Villamil, P., Granado-Lorencio, C., Riveiro, I., Acuña, A., Prieto-Piraquive, E., Janeiro, E., Matías, J.M., Patti, C., Patti, B., Mazzola, S., Jiménez, S., Duque, V. & Salmerón, F. (2010) IPez: An expert system for the taxonomic identification of fishes based on machine learning techniques. *Fisheries Research*, 102, 240-247.

Guisande, C. & Vaamonde, A. (2012) *Gráficos estadísticos y mapas con R*. Ediciones Díaz de Santos, Madrid, 367 pp.

Examples

```
## Not run:

data(Z8)
```

```
Z8<-subset(Z8,(Order == "Perciformes"))

#Example 1

F16(data=Z8, varY="M11", FactorX="Genus", group="Family", method=NULL)

#Example 2

F16(data=Z8, varY="M11", FactorX="Genus", group="Family")

## End(Not run)
```

F17 *DENSITY PLOT FOR ONE OR SEVERAL VARIABLES*

Description

It performs a density plot for one or several variables and the overlap of the area under de curve among variables is also estimated.

Usage

```
F17(data, var, kernel="gaussian", PLOT=NULL, overlap=TRUE, lty=1, lwd=2.5,
ResetPAR=TRUE, PAR=NULL, XLAB=NULL, YLAB=NULL, XLIM=NULL, YLIM=NULL,
COLOR=NULL, COLORB=NULL, LEGEND=NULL, AXIS=NULL, MTEXT= NULL, TEXT=NULL,
file="Output.csv", na="NA", dec=",", row.names=FALSE)
```

Arguments

`data`	Data file.
`var`	Variables.
`kernel`	A character string giving the smoothing kernel to be used. This must be one of "gaussian", "rectangular", "triangular", "epanechnikov", "biweight", "cosine" or "optcosine". For further details about the estimation of the density curve see the details section of the function density of base stats package.
`PLOT`	It allows to specify the characteristics of the function plot.default.
`overlap`	If it is TRUE the overlap of the area under the curve among variables is estimated. For further details about the estimation of the area under the curve see the details section of the function auc of the package kulife (Ekstrom et al., 2015).
`lty`	Type of line of the density curve for each variable. If it is a vector, it must be as many as different variables. See the description of the same argument in the function F1.
`lwd`	Line width relative to the default (default=1), so 2 is twice as wide.

ResetPAR	If it is FALSE, the default condition of the function PAR is not placed and maintained those defined by the user in previous graphics.
PAR	It accesses the function PAR that allows to modify many different aspects of the graph.
XLAB	Legend of the X axis.
YLAB	Legend of the Y axis.
XLIM	Vector with the limits of the X axis.
YLIM	Vector with the limits of the Y axis.
COLOR	Color of the density curves. It must be as many as different variables. As the color has transparency, the plot must be copy as bitmap and not metafile.
COLORB	Color of the lines. It must be as many as different variables.
LEGEND	It allows to modify the legend of the graph. If it is FALSE the legend is not shown.
AXIS	It allows to add axes to the graph.
MTEXT	It allows to add text on the margins of the graph.
TEXT	It allows to add text in any area of the inner part of the graph.
file	CSV FILE. File name with the overlap of the area under the curve among variables.
na	CSV FILE. Text that is used in the cells without data.
dec	CSV FILE. It defines if the comma "," is used as decimal separator or the dot ".".
row.names	CSV FILE. Logical value that defines if identifiers are put in rows or a vector with a text for each of the rows.

Details

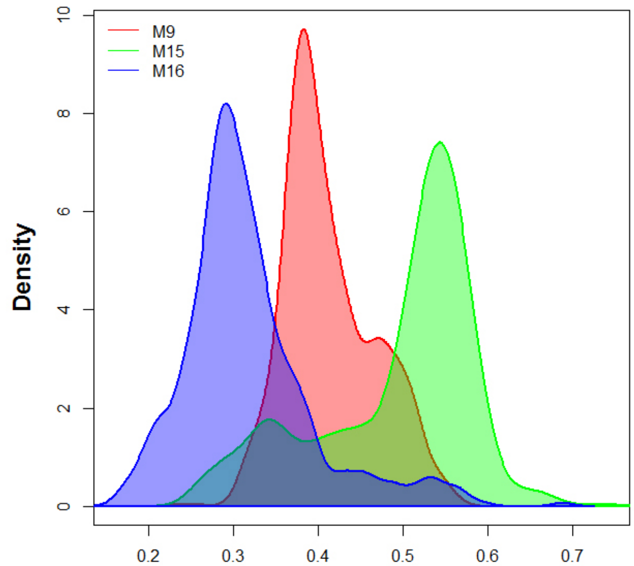
FUNCTIONS

The plot is performed with the function plot.default of base graphics package. The density curve is estimated with the function density of base stats package. The area under the curve is estimated with the function auc of the package kulife (Ekstrom et al., 2015).

EXAMPLES

For the examples, morphometric data of three families of freshwater fishes, as the distance from the origin of the dorsal fin to the origin of the anal fin (M13), the length of the dorsal fin base (M12), body height (M11), etc., are used. For details see Guisande et al. (2010).

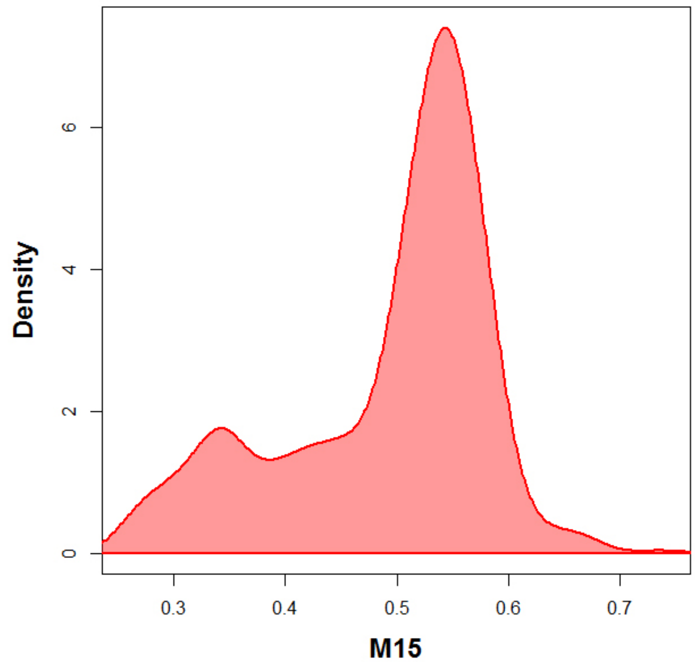
Example 1 A density plot is depicted with the variables M19, M15 and M16.



The overlap of the area under the curve among variables is obtained. The 42.02% of the area of the variable M9 overlaps with the variable M15, the 31.72% of the area of the variable M9 overlaps with the variable M16, the 42.06% of the area of the variable M15 overlaps with the variable M9, etc.

```
Variable1  Overlap Variable2
       M9 42.02573       M15
       M9 31.72632       M16
      M15 42.05860        M9
      M15 30.17896       M16
      M16 31.78222        M9
      M16 30.20850       M15
```

Example 2 A density plot is depicted with the variables M15. The legend is not shown using the argument *LEGEND=FALSE*.



Value

A density plot for one or several variables and a CSV file with the overlap of the area under de curve among variables are obtained.

References

Ekstrom, C., Skovgaard, Ib M. & Martinussen, T.(2015) Datasets and functions from the (now non-existing). R package version 0.1-14. Available at: https://CRAN.R-project.org/package=kulife.

Guisande, C., Manjarrés-Hernández, A., Pelayo-Villamil, P., Granado-Lorencio, C., Riveiro, I., Acuña, A., Prieto-Piraquive, E., Janeiro, E., Matías, J.M., Patti, C., Patti, B., Mazzola, S., Jiménez, S., Duque, V. & Salmerón, F. (2010) IPez: An expert system for the taxonomic identification of fishes based on machine learning techniques. *Fisheries Research*, 102, 240-247.

Examples

```
## Not run:

data(Z8)

#Example 1

F17(data=Z8, var=c("M9","M15","M16"))

#Example 2
```

```
F17(data=Z8, var="M15", LEGEND=FALSE, XLAB="M15")

## End(Not run)
```

F18 *DENSITY PLOT FOR ONE VARIABLE WITH DIFFERENT GROUPS*

Description

It performs a density plot of one variable with different groups and the overlap of the area under de curve among groups is also estimated.

Usage

```
F18(data, var, group, kernel="gaussian", PLOT=NULL, overlap=TRUE,
lty=1, lwd=2.5, ResetPAR=TRUE, PAR=NULL, XLAB=NULL, YLAB=NULL, XLIM=NULL,
YLIM=NULL, COLOR=NULL, COLORB=NULL, LEGEND=NULL, AXIS=NULL, MTEXT= NULL,
TEXT=NULL, file="Output.csv", na="NA", dec=",", row.names=FALSE)
```

Arguments

`data`	Data file.
`var`	Variables.
`group`	Variable with the categories to be grouped.
`kernel`	A character string giving the smoothing kernel to be used. This must be one of "gaussian", "rectangular", "triangular", "epanechnikov", "biweight", "cosine" or "optcosine". For further details about the estimation of the density curve see the details section of the function density of base stats package.
`PLOT`	It allows to specify the characteristics of the function plot.default.
`overlap`	If it is TRUE the overlap of the area under the curve among categories of the variable *group* is estimated. For further details about the estimation of the area under the curve see the details section of the function auc of the package kulife (Ekstrom et al., 2015).
`lty`	Type of line of the density curve for each group. If it is a vector, it must be as many as different categories of the variable *group*. See the description of the same argument in the function F1.
`lwd`	Line width relative to the default (default=1), so 2 is twice as wide.
`ResetPAR`	If it is FALSE, the default condition of the function PAR is not placed and maintained those defined by the user in previous graphics.
`PAR`	It accesses the function PAR that allows to modify many different aspects of the graph.
`XLAB`	Legend of the X axis.
`YLAB`	Legend of the Y axis.
`XLIM`	Vector with the limits of the X axis.

YLIM	Vector with the limits of the Y axis.
COLOR	Color of the density curves. It must be as many as different categories of the variable *group*. As the color has transparency, the plot must be copy as bitmap and not metafile.
COLORB	Color of the lines. It must be as many as different categories of the variable *group*.
LEGEND	It allows to modify the legend of the graph. If it is FALSE the legend is not shown.
AXIS	It allows to add axes to the graph.
MTEXT	It allows to add text on the margins of the graph.
TEXT	It allows to add text in any area of the inner part of the graph.
file	CSV FILE. Filename with the overlap of the area under the curve among categories of the variable *group*.
na	CSV FILE. Text that is used in the cells without data.
dec	CSV FILE. It defines if the comma "," is used as decimal separator or the dot ".".
row.names	CSV FILE. Logical value that defines if identifiers are put in rows or a vector with a text for each of the rows.

Details

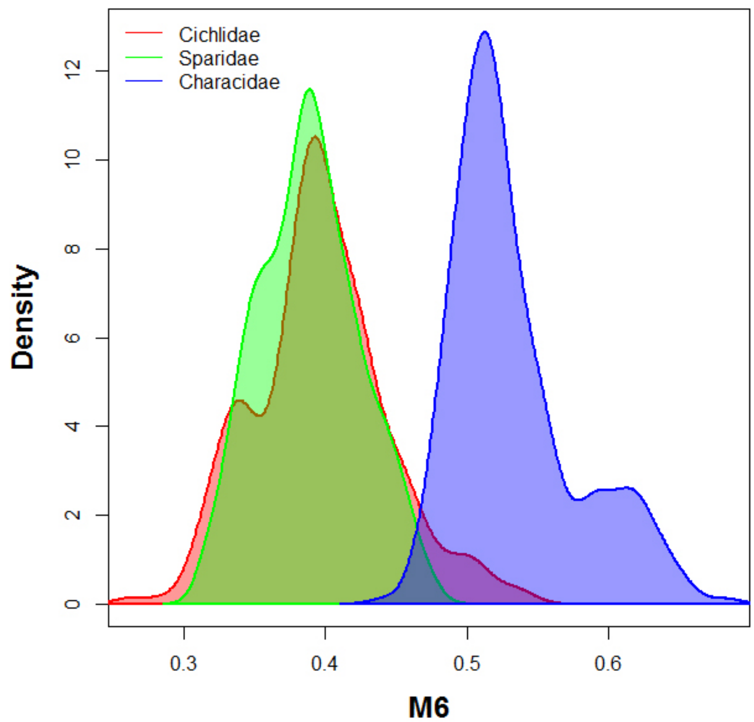
FUNCTIONS

The plot is performed with the function plot.default of base graphics package. The density curve is estimated with the function density of base stats package. The area under the curve is estimated with the function auc of the package kulife (Ekstrom et al., 2015).

EXAMPLES

For the example, morphometric data of three families of freshwater fishes, as the distance from the origin of the dorsal fin to the origin of the anal fin (M13), the length of the dorsal fin base (M12), body height (M11), etc., are used. For details see Guisande et al. (2010).

Example 1 A density plot is depicted for the variable M6 for each family.



The overlap of the area under the curve among families is obtained. The 87.87% of the area of the family Cichlidae overlaps with the family Sparidae, the 9.74% of the area of the family Cichlidae overlaps with the family Characidae, 87.69% of the area of the family Sparidae overlaps with the family Cichlidae, etc.

Group1	Overlap	Group2
Cichlidae	87.872105	Sparidae
Cichlidae	9.738575	Characidae
Sparidae	87.687612	Cichlidae
Sparidae	3.569197	Characidae
Characidae	9.733061	Cichlidae
Characidae	3.574681	Sparidae

Value

A density plot for one variable with different groups and a CSV file with the overlap of the area under de curve among groups are obtained.

References

Ekstrom, C., Skovgaard, Ib M. & Martinussen, T.(2015) Datasets and functions from the (now non-existing). R package version 0.1-14. Available at: `https://CRAN.R-project.org/package=kulife`.

Guisande, C., Manjarrés-Hernández, A., Pelayo-Villamil, P., Granado-Lorencio, C., Riveiro, I., Acuña, A., Prieto-Piraquive, E., Janeiro, E., Matías, J.M., Patti, C., Patti, B., Mazzola, S., Jiménez, S., Duque, V. & Salmerón, F. (2010) IPez: An expert system for the taxonomic identification of fishes based on machine learning techniques. *Fisheries Research*, 102, 240-247.

Examples

```
## Not run:

data(Z8)

F18(data=Z8, var="M6", group="Family")

## End(Not run)
```

F19 *HISTOGRAM WITH ONE OR SEVERAL VARIABLES*

Description

It performs a histogram with one or several variables.

Usage

```
F19(data, var, HIST=NULL, HISTh=NULL, breaks=20, varbreak=FALSE, horiz=FALSE,
line=FALSE, lty=1, lwd=2.5, ResetPAR=TRUE,  PAR=NULL,  XLAB=NULL, YLAB=NULL,
XLIM=NULL, YLIM=NULL, COLOR=NULL, COLORb="transparent", LEGEND=NULL,
AXIS=NULL, MTEXT= NULL, TEXT=NULL)
```

Arguments

`data`	Data file.
`var`	Variables.
`HIST`	It allows to specify the characteristics of the vertical histogram with the function hist.
`HISTh`	It allows to specify the characteristics of the horizontal histogram with the function barplot.
`breaks`	Number of intervals.
`varbreak`	If it is TRUE the intervals are defined by the variables.
`horiz`	If it is FALSE, the bars are drawn vertically with the first bar to the left. If it is TRUE, the bars are drawn horizontally with the first at the bottom.
`line`	If it is TRUE a density line is depicted only if the arguments *varbreak=FALSE* and *horiz=FALSE*.
`lty`	Type of line of the density curve for each variable. If it is a vector, it must be as many as different variables. See the description of the same argument in the function F1.
`lwd`	Line width relative to the default (default=1), so 2 is twice as wide.

ResetPAR	If it is FALSE, the default condition of the function PAR is not placed and maintained those defined by the user in previous graphics.
PAR	It accesses the function PAR that modifies many different aspects of the graph.
XLAB	Legend of the X axis.
YLAB	Legend of the Y axis.
XLIM	Vector with the limits of the X axis.
YLIM	Vector with the limits of the Y axis.
COLOR	Color of the borders. It must be as many as different variables.
COLORb	Color of the bars. It must be as many as different variables.
LEGEND	It modifies the legend of the graph. If it is FALSE the legend is not shown.
AXIS	It allows to add axes to the graph.
MTEXT	It allows to add text on the margins of the graph.
TEXT	It allows to add text in any area of the inner part of the graph.

Details

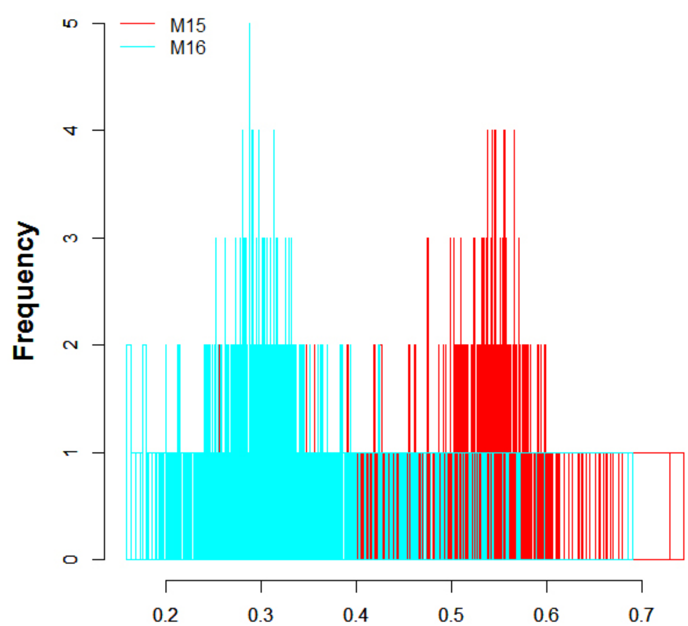
FUNCTIONS

The histograms are performed with the functions hist and barplot of base graphics package.

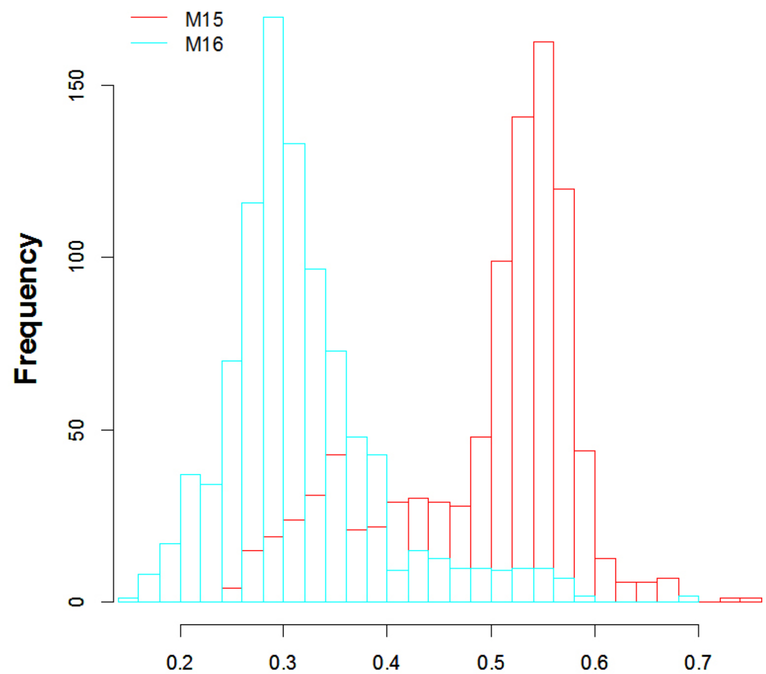
EXAMPLES

For the examples, morphometric data of three families of freshwater fishes are used. For details see Guisande et al. (2010).

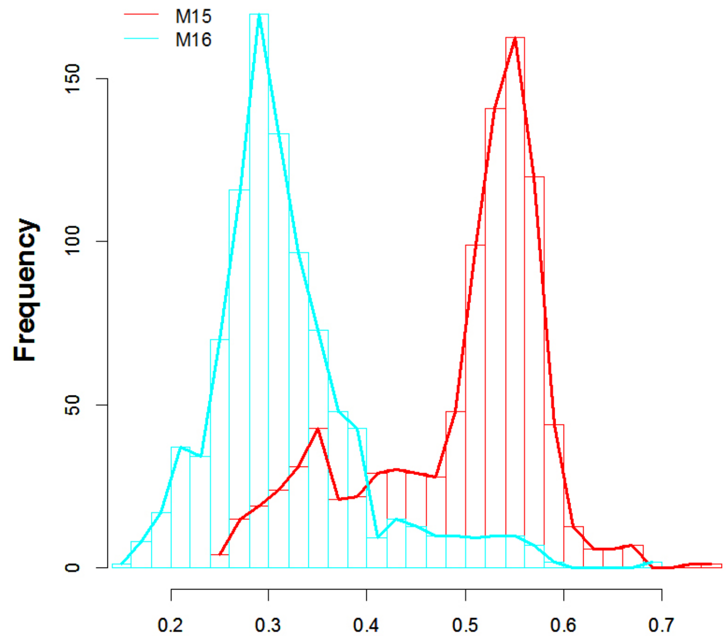
Example 1 A histogram with the intervals defined by the variables with the argument *varbreak=TRUE*.



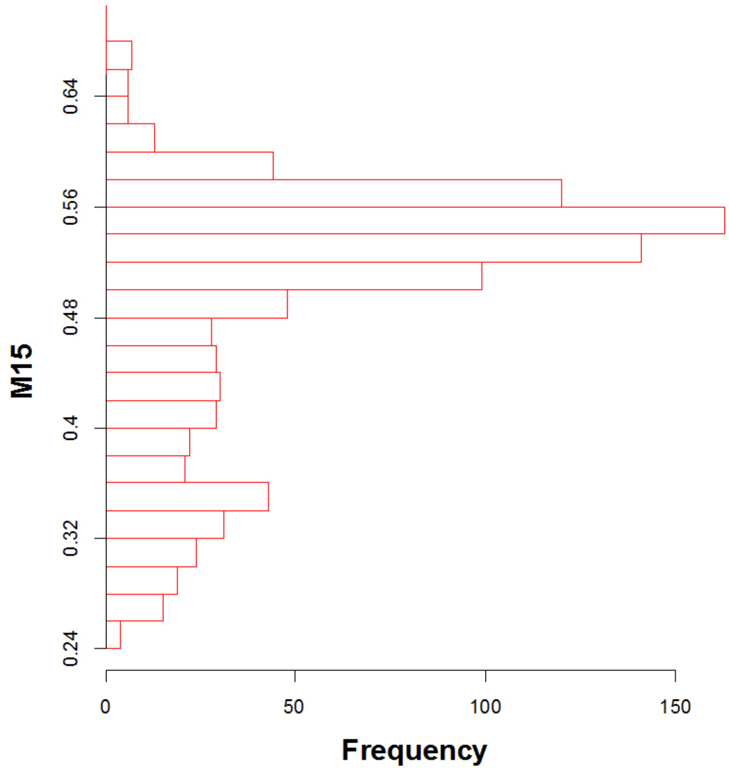
Example 2 A histogram with the intervals defined by the user. The number of intervals may be modified with the argument *breaks*.



Example 3 A density line is added with the argument *line=TRUE*.



Example 4 A histogram with one variable. The legend is not shown using the argument *LEGEND=FALSE* and the bars are horizontal with the argument *horiz=TRUE*.



Value

A histogram for one or several variables is obtained.

References

Guisande, C., Manjarrés-Hernández, A., Pelayo-Villamil, P., Granado-Lorencio, C., Riveiro, I., Acuña, A., Prieto-Piraquive, E., Janeiro, E., Matías, J.M., Patti, C., Patti, B., Mazzola, S., Jiménez, S., Duque, V. & Salmerón, F. (2010) IPez: An expert system for the taxonomic identification of fishes based on machine learning techniques. *Fisheries Research*, 102, 240-247.

Examples

```
## Not run:

data(Z8)

#Example 1

F19(data=Z8, var=c("M15","M16"), varbreak=TRUE)

#Example 2

F19(data=Z8, var=c("M15","M16"))
```

```
#Example 3

F19(data=Z8, var=c("M15","M16"), line=TRUE)

#Example 4

F19(data=Z8, var=c("M15"), horiz=TRUE, XLAB="M15", LEGEND=FALSE)

## End(Not run)
```

F2 *HISTOGRAM OF ONE VARIABLE WITH DIFFERENT GROUPS*

Description

It performs a histogram of one variable with different groups.

Usage

```
F2(data, var, group, HIST=NULL, HISTh=NULL, breaks=20, varbreak=FALSE,
horiz=FALSE, line=FALSE, lty=1, lwd=2.5, ResetPAR=TRUE,  PAR=NULL,
XLAB=NULL, YLAB=NULL, XLIM=NULL, YLIM=NULL, COLOR=NULL, COLORb="transparent",
LEGEND=NULL, AXIS=NULL, MTEXT= NULL, TEXT=NULL)
```

Arguments

`data`	Data file.
`var`	Variable.
`group`	Variable with the categories to be grouped.
`HIST`	It allows to specify the characteristics of the vertical histogram with the function hist.
`HISTh`	It allows to specify the characteristics of the horizontal histogram with the function barplot.
`breaks`	Number of intervals.
`varbreak`	If it is TRUE the intervals are defined by different categories of the variable *group*.
`horiz`	If it is FALSE, the bars are drawn vertically with the first bar to the left. If it is TRUE, the bars are drawn horizontally with the first at the bottom.
`line`	If it is TRUE a density line is depicted only if the arguments *varbreak=FALSE* and *horiz=FALSE*.
`lty`	Type of line of the density curve for each variable. If it is a vector, it must be as many as different categories of the variable *group*. See the description of the same argument in the function F1.
`lwd`	Line width relative to the default (default=1), so 2 is twice as wide.

ResetPAR	If it is FALSE, the default condition of the function PAR is not placed and maintained those defined by the user in previous graphics.
PAR	It accesses the function PAR that modifies many different aspects of the graph.
XLAB	Legend of the X axis.
YLAB	Legend of the Y axis.
XLIM	Vector with the limits of the X axis.
YLIM	Vector with the limits of the Y axis.
COLOR	Color of the borders. It must be as many as different categories of the variable *group*.
COLORb	Color of ther bars. It must be as many as different variables.
LEGEND	It modifies the legend of the graph. If it is FALSE the legend is not shown.
AXIS	It allows to add axes to the graph.
MTEXT	It allows to add text on the margins of the graph.
TEXT	It allows to add text in any area of the inner part of the graph.

Details

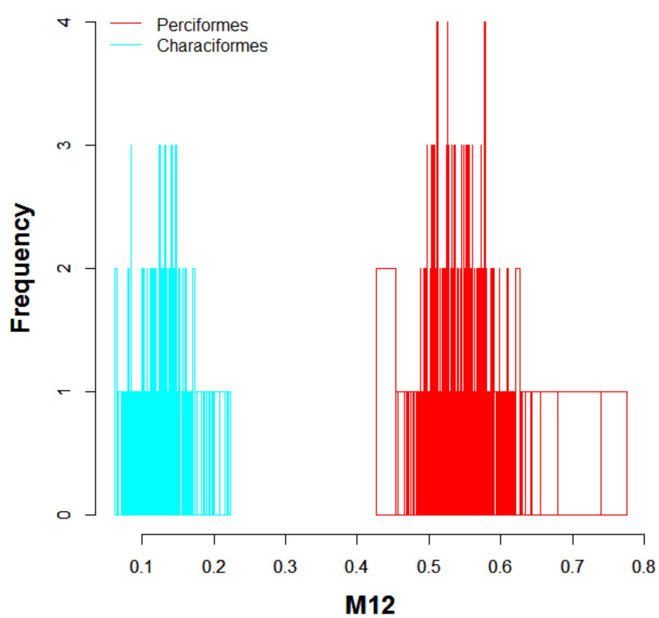
FUNCTIONS

The histograms are performed with the functions hist and barplot of base graphics package.

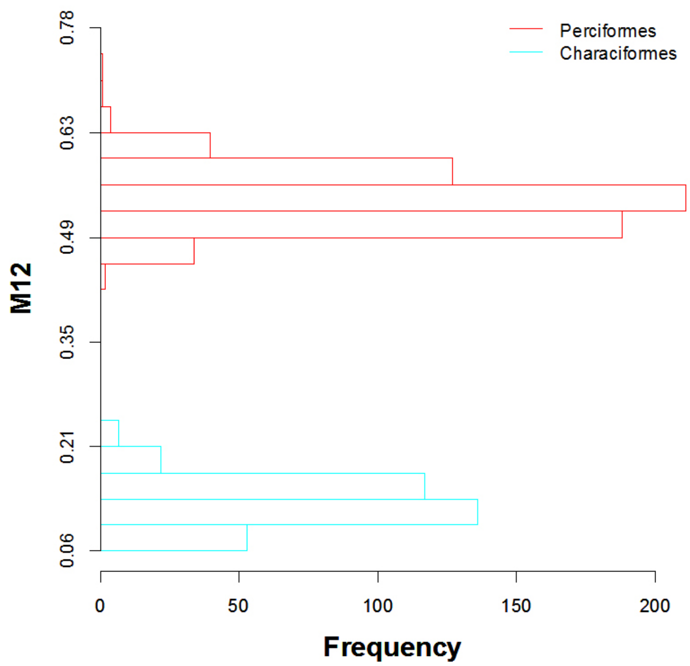
EXAMPLES

For the examples, morphometric data of three families of freshwater fishes are used. For details see Guisande et al. (2010).

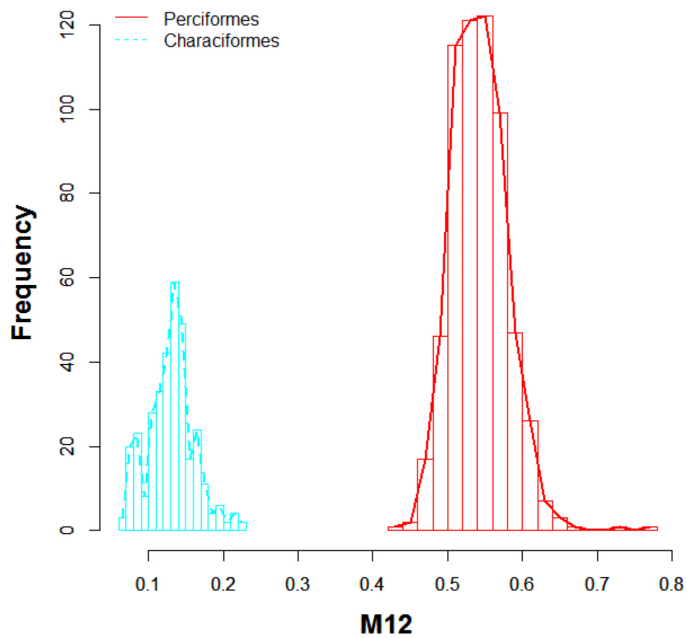
Example 1 A histogram with the intervals defined by the variables with the argument *varbreak=TRUE*.



Example 2 An horizontal histogram (*horiz=TRUE*) with the intervals defined by the user. The number of intervals may be modified with the argument *breaks*.



Example 3 A line is added with the argument *line=TRUE* and the type of line for each group is defined with the argument *lty=c(1,2)*



Value

A histogram for one variable with different groups is obtained.

References

Guisande, C., Manjarrés-Hernández, A., Pelayo-Villamil, P., Granado-Lorencio, C., Riveiro, I., Acuña, A., Prieto-Piraquive, E., Janeiro, E., Matías, J.M., Patti, C., Patti, B., Mazzola, S., Jiménez, S., Duque, V. & Salmerón, F. (2010) IPez: An expert system for the taxonomic identification of fishes based on machine learning techniques. *Fisheries Research*, 102, 240-247.

Examples

```
## Not run:

data(Z8)

#Examle 1

F2(data=Z8, var="M12", group="Order", varbreak=TRUE)

#Examle 2

F2(data=Z8, var="M12", group="Order", horiz=TRUE)

#Examle 3

F2(data=Z8, var="M12", group="Order", line=TRUE, lty=c(1,2))
```

```
## End(Not run)
```

F20 *DOT HISTOGRAM WITH ONE OR SEVERAL VARIABLES*

Description

It performs a dot histogram with one or several variables.

Usage

```
F20(data, var, ResetPAR=TRUE, PAR=NULL, YLAB=NULL, XLIM=NULL,
COLOR=NULL, PCH=16, LEGEND=NULL, AXIS=NULL, MTEXT= NULL, TEXT=NULL)
```

Arguments

`data`	Data file.
`var`	Variables.
`ResetPAR`	If it is FALSE, the default condition of the function PAR is not placed and maintained those defined by the user in previous graphics.
`PAR`	It accesses the function PAR that allows to modify many different aspects of the graph.
`YLAB`	Legend of the Y axis.
`XLIM`	Vector with the limits of the X axis.
`COLOR`	Color of the dots.
`PCH`	Graphic symbol (see the description of the same argument in the function F1).
`LEGEND`	It allows to add a legend to the graph.
`AXIS`	It allows to add axes to the graph.
`MTEXT`	It allows to add text on the margins of the graph.
`TEXT`	It allows to add text in any area of the inner part of the graph.

Details

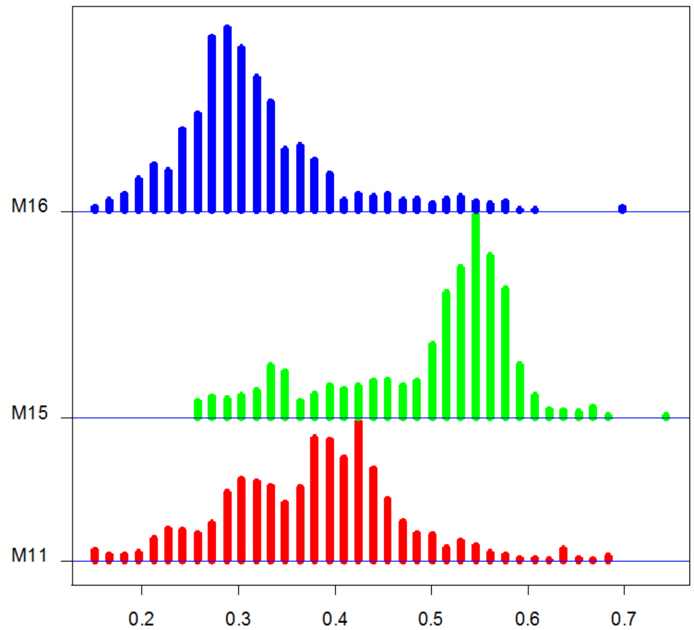
FUNCTIONS

The dot histogram is performed with the function dotplot of the package epicalc (Chongsuvivatwong, 2012).

EXAMPLES

For the examples, morphometric data of three families of freshwater fishes, as the distance from the origin of the dorsal fin to the origin of the anal fin (M13), the length of the dorsal fin base (M12), body height (M11), etc., are used. For details see Guisande et al. (2010).

A dot histogram is depicted for three variables: M11, M15 and M12.



Value

A dot histogram for one or several variables is obtained.

References

Guisande, C., Manjarrés-Hernández, A., Pelayo-Villamil, P., Granado-Lorencio, C., Riveiro, I., Acuña, A., Prieto-Piraquive, E., Janeiro, E., Matías, J.M., Patti, C., Patti, B., Mazzola, S., Jiménez, S., Duque, V. & Salmerón, F. (2010) IPez: An expert system for the taxonomic identification of fishes based on machine learning techniques. *Fisheries Research*, 102, 240-247.

Chongsuvivatwong, V. (2012) Epidemiological calculator. R package version 2.15.1.0. Available at: https://cran.r-project.org/src/contrib/Archive/epicalc/.

Examples

```
## Not run:

data(Z8)

F20(data=Z8, var=c("M11","M15","M16"))

## End(Not run)
```

F21 *DOT HISTOGRAM OF ONE VARIABLE WITH DIFFERENT GROUPS*

Description

It performs a dot histogram of one variable with different groups.

Usage

```
F21(data, var, group, ResetPAR=TRUE, PAR=NULL, YLAB=NULL,
XLIM=NULL, COLOR=NULL, PCH=16, LEGEND=NULL, AXIS=NULL, MTEXT= NULL, TEXT=NULL)
```

Arguments

`data`	Data file.
`var`	Variable.
`group`	Variable with the categories to be grouped.
`ResetPAR`	If it is FALSE, the default condition of the function PAR is not placed and maintained those defined by the user in previous graphics.
`PAR`	It accesses the function PAR that allows to modify many different aspects of the graph.
`YLAB`	Legend of the Y axis.
`XLIM`	Vector with the limits of the X axis.
`COLOR`	Color of the dots.
`PCH`	Graphic symbol (see the description of the same argument in the function F1).
`LEGEND`	It allows to add a legend to the graph.
`AXIS`	It allows to add axes to the graph.
`MTEXT`	It allows to add text on the margins of the graph.
`TEXT`	It allows to add text in any area of the inner part of the graph.

Details

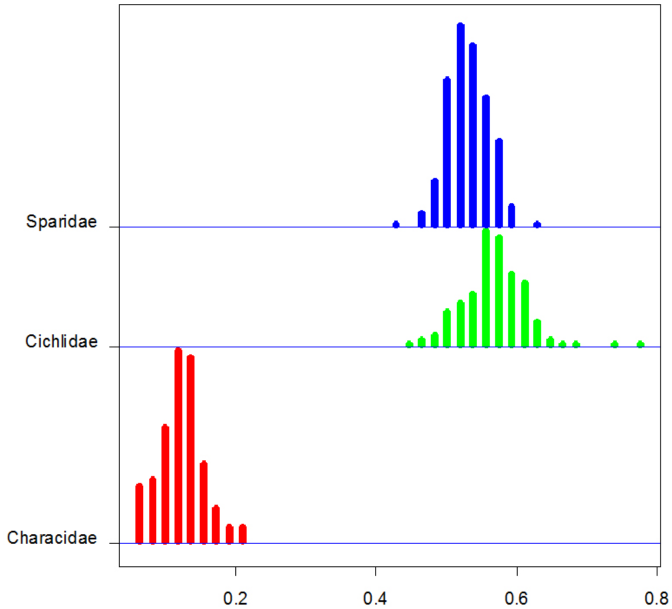
FUNCTIONS

The dot histogram is performed with the function dotplot of the package epicalc (Chongsuvivatwong, 2012).

EXAMPLES

For the examples, morphometric data of three families of freshwater fishes, as the distance from the origin of the dorsal fin to the origin of the anal fin (M13), the length of the dorsal fin base (M12), body height (M11), etc., are used. For details see Guisande et al. (2010).

A dot histogram is depicted for the variable M12 grouping by families.



Value

A dot histogram of one variable with different groups is obtained.

References

Guisande, C., Manjarrés-Hernández, A., Pelayo-Villamil, P., Granado-Lorencio, C., Riveiro, I., Acuña, A., Prieto-Piraquive, E., Janeiro, E., Matías, J.M., Patti, C., Patti, B., Mazzola, S., Jiménez, S., Duque, V. & Salmerón, F. (2010) IPez: An expert system for the taxonomic identification of fishes based on machine learning techniques. *Fisheries Research*, 102, 240-247.

Chongsuvivatwong, V. (2012) Epidemiological calculator. R package version 2.15.1.0. Available at: https://cran.r-project.org/src/contrib/Archive/epicalc/.

Examples

```
## Not run:

data(Z8)

F21(data=Z8, var="M12", group="Family")

## End(Not run)
```

F22 *SIMPLE MEAN WITH ERROR BARS SCATTER PLOT FOR VARIABLE X QUANTITATIVE WITH TEXT LABELS AND REGRESSION*

Description

It performs a simple mean with error bars scatter plot for variable X quantitative with text labels and a regression model.

Usage

```
F22(data, varY,  varX, Factor, method="mean", dev="sd", barY=TRUE,
barX=FALSE, textlabel=FALSE, label=NULL, reg=FALSE, model="Linear",
outliers=FALSE, quant1=0.05, quant2 = 0.95, ResetPAR=TRUE, PAR=NULL,
XLAB=NULL, YLAB=NULL, XLIM=NULL, YLIM=NULL,  COLOR="black", COLORI="black",
COLORR="red", PCH=16, lty=3, lwd=2.5, R2.pos="topleft", PLOT=NULL,
LEGEND=NULL, AXIS=NULL, MTEXT= NULL, TEXT=NULL, file1="Output.txt",
file2="Average and error bars.csv", na="NA", dec=",", row.names=FALSE)
```

Arguments

`data`	Data file.
`varY`	Dependent variable.
`varX`	Quantitative independent variable.
`Factor`	Variable for the estimation of the average and error bars for each category of the variable. It is not possible to include variables with any of the categories with a single data, so if necessary several data for each category.
`method`	The average of each category of the grouped variable *Factor* is estimated with the "mean" or the "median".
`dev`	The error bars may be estimated using the standard deviation ("sd") or the standard error ("se").
`barY`	If it is TRUE the bar error of the variable Y is depicted.
`barX`	If it is TRUE the bar error of the variable X is depicted.
`textlabel`	If TRUE the text labels of the categories of the variable *Factor* are added to the plot.
`label`	It allows to specify the characteristics of the text labels with the function text.
`reg`	If it is TRUE a regression model is performed.
`model`	One regression model can be selected: "Linear" , "Log", "S-curve", "Power", "Exp", "Quadratic", "Cubic", "Inverse". It is not considered the model in those cases in which there is the logarithm that apply to any of the variables, if any value of the variable, which applies the logarithm, is zero or negative. The inverse model is not calculated if any value of the independent variable is zero.
`outliers`	If it is TRUE, the outliers are removed using the selected regression model.

quant1 Quantile of the lower end to the elimination of outliers.

quant2 Quantile of the upper end to the elimination of outliers.

ResetPAR If it is FALSE, the default condition of the function PAR is not placed and maintained those defined by the user in previous graphics.

PAR It accesses the function PAR that allows to modify many different aspects of the graph.

XLAB Legend of the X axis.

YLAB Legend of the Y axis.

XLIM Vector with the limits of the X axis.

YLIM Vector with the limits of the Y axis.

COLOR Color of the symbols.

COLORI Color of the error bars.

COLORR Color of the line of the regression model.

PCH Graphic symbol (see the description of the same argument in the function F1).

lty Type of the regression line (see the description of the same argument in the function F1).

lwd Line width of the regression line relative to the default (default=1), so 2 is twice as wide.

R2.pos If it is not NULL, with this argument is possible to specify the position of the r^2 of the regression in the scatter plot.

PLOT It allows to specify the characteristics of the function plot.default.

LEGEND It allows to include a legend to the graph.

AXIS It allows to add axes to the graph.

MTEXT It allows to add text on the margins of the graph.

TEXT It allows to add text in any area of the inner part of the graph.

file1 TXT FILE. If the argument *reg=TRUE* a TXT file is saved with the information of the regression.

file2 CSV FILE. File name with the mean, median, standard error and standard deviation for each category of the variable *Factor*.

na CSV FILES. Text that is used in the cells without data.

dec CSV FILES. It defines if the comma "," is used as decimal separator or the dot ".".

row.names CSV FILES. Logical value that defines if identifiers are put in rows or a vector with a text for each of the rows.

Details

See the equations of all regression models in the section *details* of the function XI1 of the package StatR.

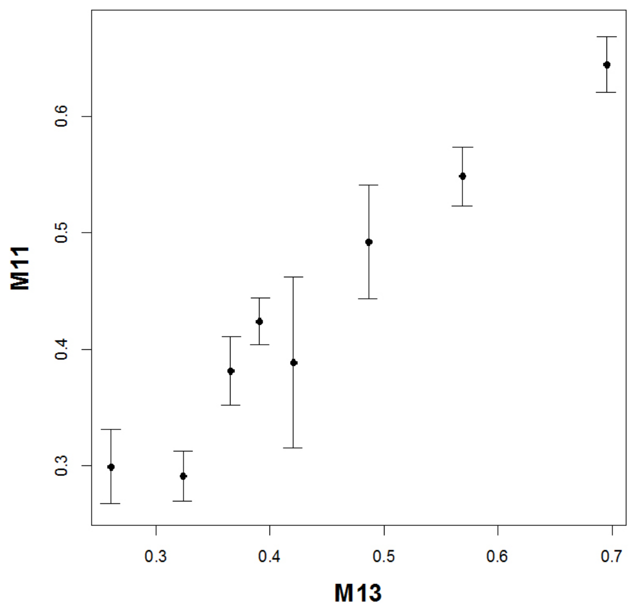
FUNCTIONS

The plot is performed with the function plot.default of base graphics package and the linear regression with the function lm of base stats package. The function lillie.test of the package nortest (Gross, 2013) is used to perform the test of Normality Kolmogorov-Smirnov with Lilliefors'correction, the function dwtest of the package lmtest (Hothorn et al., 2013) to analyze the autocorrelation with the test and the Durbin-Watson statistic function bptest of the package lmtest (Hothorn et al., 2013) to perform the Breusch-Pagan test of homoscedasticity.

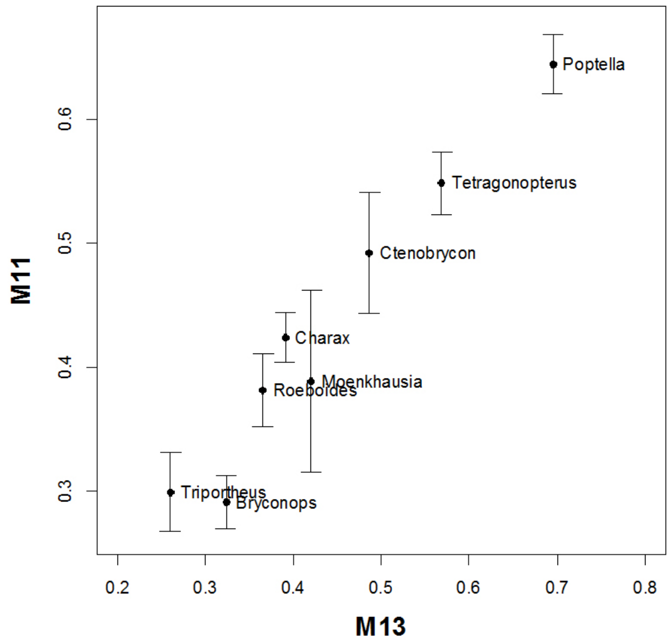
EXAMPLES

For the examples, morphometric data of several fish species of Characiforms are used. For details see Guisande et al. (2010). It is shown the relationship between M11 and M13 for all genera.

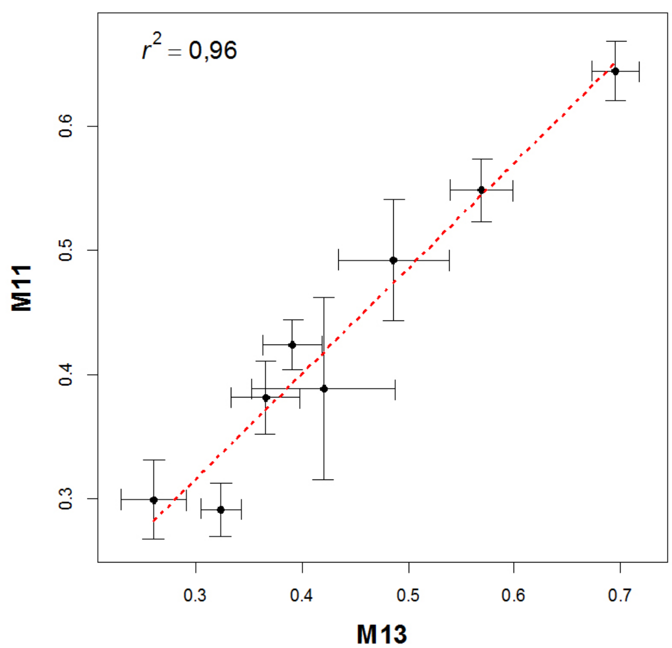
Example 1 Relationship between the mean values of M13 and M11 for each genera with the standard deviation of the M11.



Example 2 As in the example 1 but adding the text labels of the genera with the argument *textlabel=TRUE*.



Example 3 As in the example 1 but a linear regression line is added with the argument *reg=TRUE* and also is shown the standard deviation on the variable M13 with the argument *barX=TRUE*.



In the TXT file that generates the function, the linear regression linear is shown, where the variable

M13 is significant (p < 0.001, see *Pr(>|t|)*) and, therefore, the model as a whole was also significant (p < 0.001, see *p-value* at the end of the results).

The r^2 (see *Multiple R-squared*) shows that the M13 explains a 95.6% of the observed variance in the M11. The r^2 adjusted (see *Ajusted R-squared*) takes into account the size of the sample to determine the proportion above and, in this case, it shows a lower value 94.9%. The r^2 adjusted should be used to compare models with different numbers of observations or independent variables. The equation of the potential regression model must be expressed in this way: $M11 = 0.061 + 0.847 * M13$

```
[1] "LINEAR REGRESSION"

[[2]]

Call:
lm(formula = fo, data = datos2)

Residuals:
      Min        1Q    Median        3Q       Max 
-0.044141 -0.012735  0.007289  0.017412  0.030719 

Coefficients:
            Estimate Std. Error t value Pr(>|t|)    
(Intercept)  0.06171    0.03397   1.817    0.119    
M13          0.84765    0.07416  11.430 2.69e-05 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.02756 on 6 degrees of freedom
Multiple R-squared:  0.9561,	Adjusted R-squared:  0.9488 
F-statistic: 130.7 on 1 and 6 DF,  p-value: 2.69e-05
```

In the following table, the results of the test of Kolmogorov-Smirnov normality with Lilliefors' correction, the test for autocorrelation of Durbin-Watson statistic and the Breusch-Pagan test of homoscedasticity are shown.

Normality The residuals do have a Normal distribution with p = 0.485. If the assumption of normality is not complied, this would not invalidate the model as it is very predictive with a r^2 very high. The problem resulting from not Normal residuals is that there can be no assurance that the degree of significance, probability value that shows the model, is the correct one.

Autocorrelation The requirement that there should be no autocorrelation is also met because in the test of Durbin-Watson statistic p = 0.532. This means that the value of r^2 of the 95.6% is all due to the dependent variable, the M13, so it is not in part due to the own dependent variable that is auto explained. If there is autocorrelation, it is not possible to know exactly how much is the variance explained by the independent variable. Anyway it is necessary to mention that the probability value of the test of Durbin-Watson statistic can be less than 0.05 easily when there are many data. The statistical DW, whose value is 1.97 in this example, is a better indicator of the autocorrelation when the number of data is very large. According to Durbin & Watson (1951), a DW less than 1 means a strong positive autocorrelation, a DW greater than 4 a strong negative autocorrelation, values between 1 and 3 a moderate autocorrelation, and a value close to 2 means that there is no autocorrelation.

Homoscedasticity Finally, the requirement of homoscedasticity of the residuals is also satisfied, because the likelihood of the Breusch-Pagan test is p = 0.173. If this requirement is not fulfilled, it means that the model is not as predictive for the entire range of values of the dependent variable.

```
[1] "Normality"

[[4]]

	Lilliefors (Kolmogorov-Smirnov) normality test

data:  res
D = 0.1961, p-value = 0.4855


[[5]]
[1] "Autocorrelation"

[[6]]

	Durbin-Watson test

data:  reg
DW = 1.9771, p-value = 0.532
alternative hypothesis: true autocorrelation is greater than 0


[[7]]
[1] "Homocedasticity"

[[8]]

	studentized Breusch-Pagan test

data:  reg
BP = 1.8712, df = 1, p-value = 0.1713
```

Value

A simple scatter plot with mean error bars, with or without linear regression and with or without text labels is obtained. A CVS file with the mean, median, standard error and standard deviation for each category of the variable *Factor* is also obtained.

References

Durbin, J. & Watson G.S. (1951) Testing for serial correlation in least squares regression. *Biometrika*, **38**, 159-171.

Gross, J. (2013) Tests for Normality. R package version 1.0-2. Available at: https://CRAN.R-project.org/package=nortest.

Guisande, C., Manjarrés-Hernández, A., Pelayo-Villamil, P., Granado-Lorencio, C., Riveiro, I., Acuña, A., Prieto-Piraquive, E., Janeiro, E., Matías, J.M., Patti, C., Patti, B., Mazzola, S., Jiménez, S., Duque, V. & Salmerón, F. (2010) IPez: An expert system for the taxonomic identification of fishes based on machine learning techniques. *Fisheries Research*, 102, 240-247.

Hothorn, T. et al., (2013) Testing Linear Regression Models. R package version 0.9-33. Available at: https://CRAN.R-project.org/package=lmtest.

Examples

```
## Not run:

#Example 1

data(Z1)
```

```
F22(data=Z1, varY="M11", varX="M13", Factor="Genus")

#Example 2

F22(data=Z1, varY="M11", varX="M13", Factor="Genus", textlabel=TRUE, XLIM=c(0.2,0.8))

#Example 3

F22(data=Z1, varY="M11", varX="M13", Factor="Genus", barX=TRUE, reg=TRUE)


## End(Not run)
```

F23 *SIMPLE DOT AND SCATTER PLOTS FOR VARIABLE X QUALITATIVE*

Description

It performs a simple dot or mean with error bars scatter plots for variable X qualitative.

Usage

```
F23(data, varY,  FactorX, method="mean", dev="sd", ResetPAR=TRUE, PAR=NULL,
order=NULL, OrderCat=NULL, LabelCat=NULL, XLAB=NULL, YLAB=NULL, XLIM=NULL,
YLIM=NULL, COLOR="black",  COLORI="black", PCH=16, CEX=1, LEGEND=NULL,
AXIS=NULL, MTEXT= NULL, TEXT=NULL)
```

Arguments

`data`	Data file.
`varY`	Dependent variable.
`FactorX`	Qualitative independent variable.
`method`	If it is not NULL, the average of each category of the independent variable *FactorX* is estimated with the "mean" or the "median".
`dev`	If the argument *method* is not NULL, the error bars may be estimated using the standard deviation ("sd") or the standard error ("se").
`ResetPAR`	If it is FALSE, the default condition of the function PAR is not placed and maintained those defined by the user in previous graphics.
`PAR`	It accesses the function PAR that allows to modify many different aspects of the graph.
`order`	If it is NULL the categories are ordered as found in the variable *FactorX*, if it is "increasing" are ordered from lesser to greater median or mean according to the method selected in the argument *method*, if it is "decreasing" are ordered from greater to lesser median or mean, if it is "alhaAZ" are ordered from A to Z and if it is "alphaZA" from Z to A.

OrderCat	It allows to specify a vector with the order in which the categories are shown. If this argument is specified, the argument *order* is not taken into account.
LabelCat	It allows to specify a vector with the names of the categories.
XLAB	Legend of the X axis.
YLAB	Legend of the Y axis.
XLIM	Vector with the limits of the X axis.
YLIM	Vector with the limits of the Y axis.
COLOR	Color of the symbols.
COLORI	Color of the error bars.
PCH	Graphic symbol (see the description of the same argument in the function F1).
CEX	Size of the symbols.
LEGEND	It allows to include a legend to the graph.
AXIS	It allows to add axes to the graph.
MTEXT	It allows to add text on the margins of the graph.
TEXT	It allows to add text in any area of the inner part of the graph.

Details

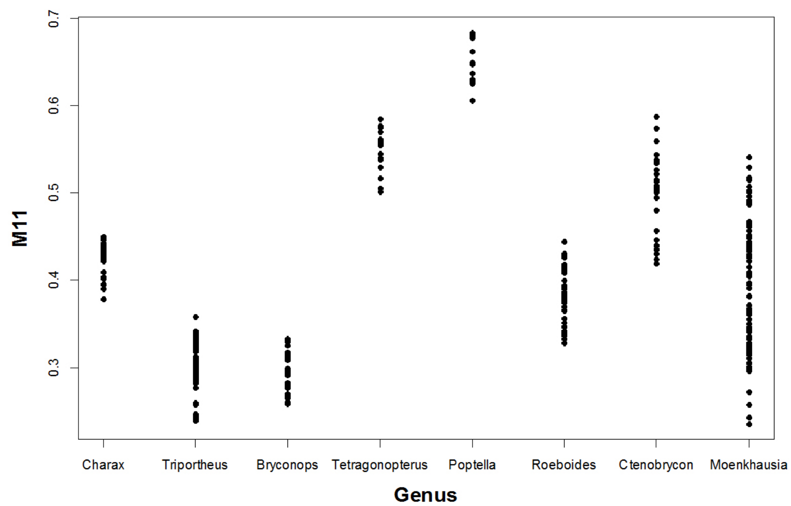
FUNCTIONS

The plot is performed with the functions boxplot, points and arrows of base graphics package. For further details see Guisande & Vammonde (2012).

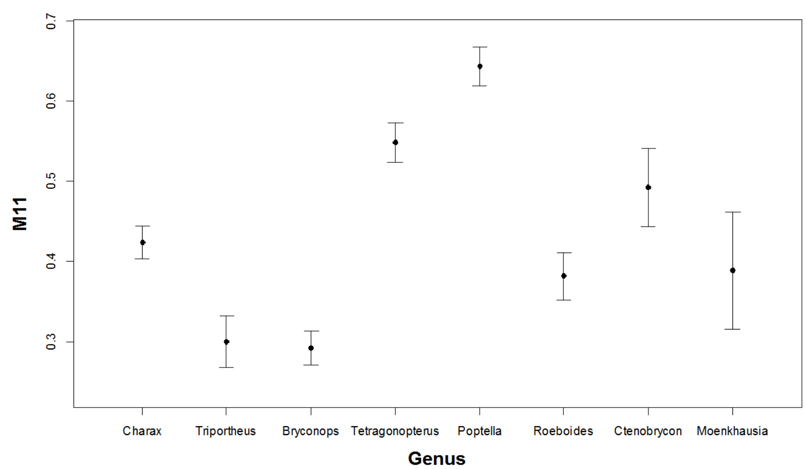
EXAMPLES

For the examples, morphometric data of several fish species of Characiforms, as the distance from the origin of the dorsal fin to the origin of the anal fin (M13), the length of the dorsal fin base (M12), body height (M11), etc., are used. For details see Guisande et al. (2010).

Example 1 A dot plot is depicted with the argument *method=NULL* of the variable M11 for all genera of fishes.



Example 2 The mean and the standard deviation of the variable M11 is obtained for each genus.



Value

A dot or mean scatter plots are obtained.

References

Guisande, C., Manjarrés-Hernández, A., Pelayo-Villamil, P., Granado-Lorencio, C., Riveiro, I., Acuña, A., Prieto-Piraquive, E., Janeiro, E., Matías, J.M., Patti, C., Patti, B., Mazzola, S., Jiménez, S., Duque, V. & Salmerón, F. (2010) IPez: An expert system for the taxonomic identification of fishes based on machine learning techniques. *Fisheries Research*, 102, 240-247.

Guisande, C. & Vaamonde, A. (2012) *Gráficos estadísticos y mapas con R*. Ediciones Díaz de Santos, Madrid, 367 pp.

Examples

```
## Not run:

#Example 1

data(Z1)

F23(data=Z1, varY="M11", Factor="Genus", method=NULL)

#Example 2

F23(data=Z1, varY="M11", Factor="Genus")

## End(Not run)
```

F24 — *SIMPLE MEAN WITH ERROR BARS SCATTER PLOT FOR VARIABLE X QUALITATIVE WITH TEXT LABELS*

Description

It performs a simple mean with error bars scatter plot for variable X qualitative with text labels.

Usage

```
F24(data, varY,  FactorX, label=NULL, method="mean", dev="sd", ResetPAR=TRUE,
PAR=NULL, order=NULL, OrderCat=NULL, LabelCat=NULL, XLAB=NULL, YLAB=NULL,
XLIM=NULL, YLIM=NULL, COLOR="black",  COLORI="black", PCH=16, CEX=1,
LEGEND=NULL, AXIS=NULL, MTEXT= NULL, TEXT=NULL)
```

Arguments

`data`	Data file.
`varY`	Dependent variable.
`FactorX`	Qualitative independent variable.
`label`	It allows to specify the characteristics of the text labels with the function text.
`method`	The average of each category of the independent variable *FactorX* is estimated with the "mean" or the "median".
`dev`	The error bars may be estimated using the standard deviation ("sd") or the standard error ("se").
`ResetPAR`	If it is FALSE, the default condition of the function PAR is not placed and maintained those defined by the user in previous graphics.
`PAR`	It accesses the function PAR that allows to modify many different aspects of the graph.

`order`	If it is NULL the categories are ordered as found in the variable *FactorX*, if it is "increasing" are ordered from lesser to greater median or mean according to the method selected in the argument *method*, if it is "decreasing" are ordered from greater to lesser median or mean, if it is "alhaAZ" are ordered from A to Z and if it is "alphaZA" from Z to A.
`OrderCat`	It allows to specify a vector with the order in which the categories are shown. If this argument is specified, the argument *order* is not taken into account.
`LabelCat`	It allows to specify a vector with the names of the categories.
`XLAB`	Legend of the X axis.
`YLAB`	Legend of the Y axis.
`XLIM`	Vector with the limits of the X axis.
`YLIM`	Vector with the limits of the Y axis.
`COLOR`	Color of the symbols.
`COLORI`	Color of the error bars.
`PCH`	Graphic symbol (see the description of the same argument in the function F1).
`CEX`	Size of the symbols.
`LEGEND`	It allows to include a legend to the graph.
`AXIS`	It allows to add axes to the graph.
`MTEXT`	It allows to add text on the margins of the graph.
`TEXT`	It allows to add text in any area of the inner part of the graph.

Details

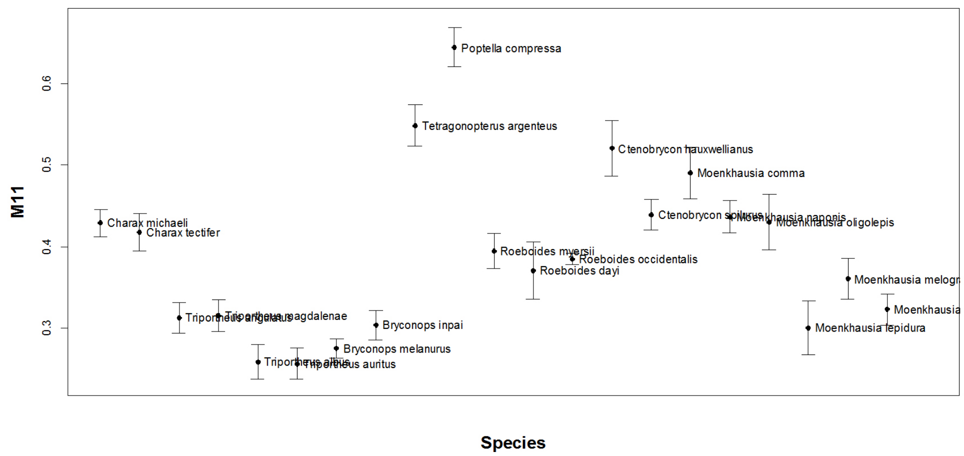
FUNCTIONS

The plot is performed with the functions boxplot, points and arrows, and the text labels with the funcion text, all of them of base graphics package. For further details see Guisande & Vammonde (2012).

EXAMPLES

For the examples, morphometric data of several fish species of Characiforms, as the distance from the origin of the dorsal fin to the origin of the anal fin (M13), the length of the dorsal fin base (M12), body height (M11), etc., are used. For details see Guisande et al. (2010).

A scatter plot is depicted with the mean value and standar deviation of the variable M11 for all species, showing the species with text labels.



Value

A mean with error bars scatter plot with text labels is obtained.

References

Guisande, C., Manjarrés-Hernández, A., Pelayo-Villamil, P., Granado-Lorencio, C., Riveiro, I., Acuña, A., Prieto-Piraquive, E., Janeiro, E., Matías, J.M., Patti, C., Patti, B., Mazzola, S., Jiménez, S., Duque, V. & Salmerón, F. (2010) IPez: An expert system for the taxonomic identification of fishes based on machine learning techniques. *Fisheries Research*, 102, 240-247.

Guisande, C. & Vaamonde, A. (2012) *Gráficos estadísticos y mapas con R*. Ediciones Díaz de Santos, Madrid, 367 pp.

Examples

```
## Not run:

data(Z1)

F24(data=Z1, varY="M11", FactorX="Species")

## End(Not run)
```

`F25` *BOX AND WHISKER PLOTS*

Description

It performs box and whisker plots.

Usage

```
F25(data, varY, varX, order=NULL, jitter=FALSE, ResetPAR=TRUE, PAR=NULL,
OrderCat=NULL, LabelCat=NULL, COLOR=NULL, BOXPLOT=NULL, LEGEND=NULL,
AXIS=NULL, MTEXT= NULL, TEXT=NULL)
```

Arguments

`data`	Data file.
`varY`	Dependent variable.
`varX`	Variable with the categories.
`order`	If it is NULL the categories are ordered as found in the variable *varX*, if it is "increasing" are ordered from lesser to greater median, if it is "decreasing" are ordered from greater to lesser median, if it is "alhaAZ" are ordered from A to Z and if it is "alphaZA" from Z to A.
`jitter`	If it is TRUE points are added with the function jitter of the base package.
`ResetPAR`	If it is FALSE, the default condition of the function PAR is not placed and maintained those defined by the user in previous graphics.
`PAR`	It accesses the function PAR that allows to modify many different aspects of the graph.
`OrderCat`	It allows to specify a vector with the order in which the categories are shown. If this argument is specified, the argument *order* is not taken into account.
`LabelCat`	It allows to specify a vector with the names of the categories.
`COLOR`	Vector with the color of the categories or just one color for all categories.
`BOXPLOT`	It allows to specify the characteristics of the function boxplot.
`LEGEND`	It allows to include a legend to the graph.
`AXIS`	It allows to add axes to the graph.
`MTEXT`	It allows to add text on the margins of the graph.
`TEXT`	It allows to add text in any area of the inner part of the graph.

Details

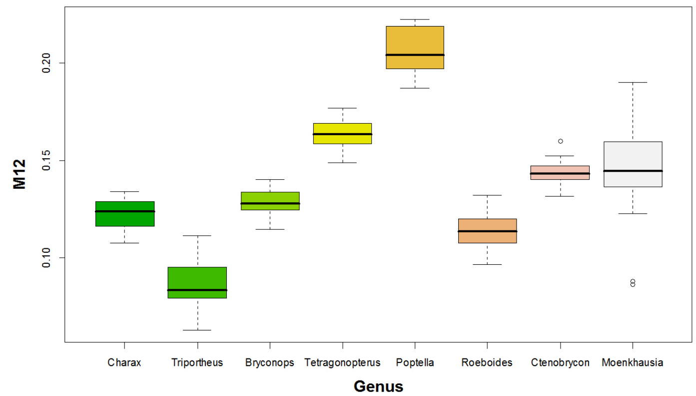
FUNCTIONS

The plot is performed with the functions boxplot of the graphics package and jitter of the base package.

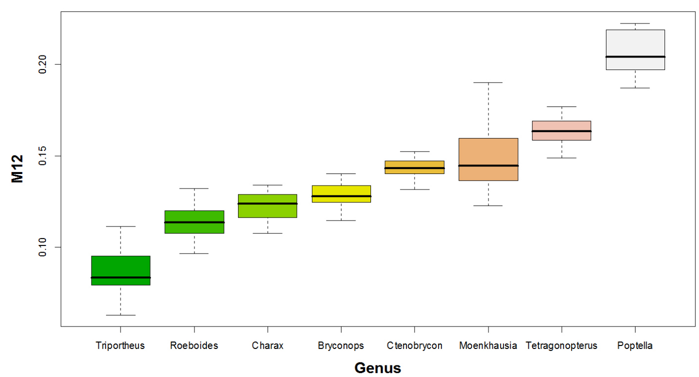
EXAMPLES

For the examples, morphometric data of several fish species of Characiforms, as the length of the dorsal fin base (M12), body height (M11), etc., are used. For details see Guisande et al. (2010). It is shown the length of the dorsal fin base (M12) for all genera.

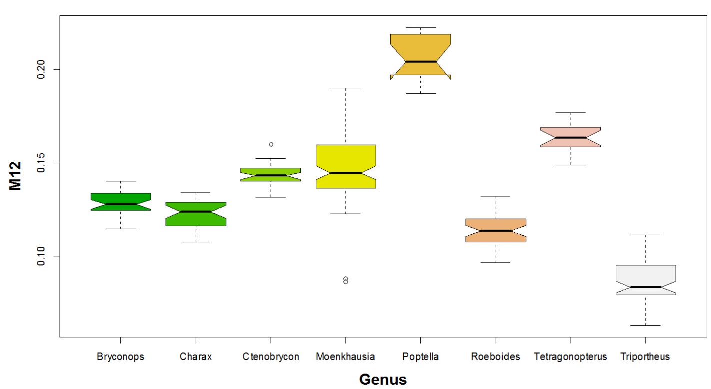
Example 1. Genera are ordered as found in the varX.



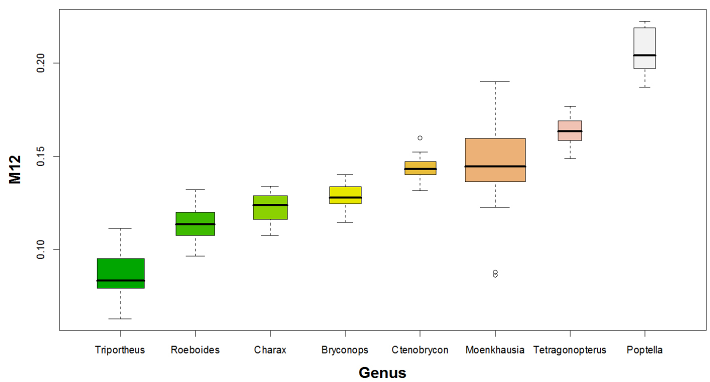
Example 2. Genera are ordered from lesser to greater median with the argument (*order="increasing"*) and outliers are removed (in the argument *BOXPLOT* select *outline=FALSE*).



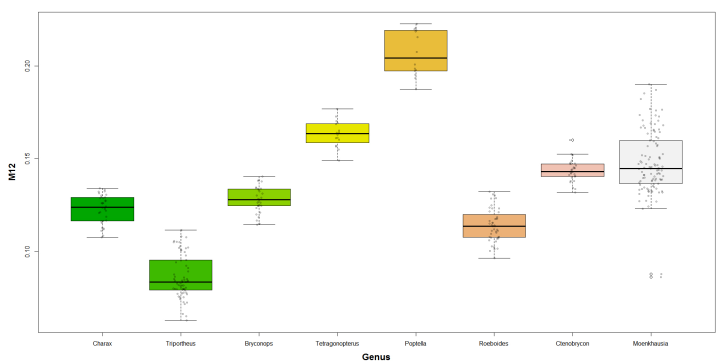
Example 3. Genera are plotted in alphabetical order from A to Z with the argument (*order="alphaAZ"*) and a notch is included (in the argument *BOXPLOT* select *notch=TRUE*). If the notches of two plots do not overlap this is an evidence that the two medians differ (Chambers et al, 1983, p. 62). See boxplot.stats for the calculations used.



Example 4. Genera are ordered from greater to lesser median with the argument (*order="decreasing"*) and the boxes are drawn with widths proportional to the square-roots of the number of observations in the groups (in the argument *BOXPLOT* select *varwidth=TRUE*).



Example 5. As in the example 1 but with the argument *jitter=TRUE*



Value

A box or whisker plot is obtained.

References

Chambers, J. M., Cleveland, W. S., Kleiner, B. and Tukey, P. A. (1983) *Graphical Methods for Data Analysis*. Wadsworth & Brooks/Cole.

Guisande, C., Manjarrés-Hernández, A., Pelayo-Villamil, P., Granado-Lorencio, C., Riveiro, I., Acuña, A., Prieto-Piraquive, E., Janeiro, E., Matías, J.M., Patti, C., Patti, B., Mazzola, S., Jiménez, S., Duque, V. & Salmerón, F. (2010) IPez: An expert system for the taxonomic identification of fishes based on machine learning techniques. *Fisheries Research*, 102, 240-247.

Examples

```
## Not run:
```

```
data(Z1)

#Example 1.

F25(data=Z1, varY="M12", varX="Genus")

#Example 2.

F25(data=Z1, varY="M12", varX="Genus", order="increasing",
BOXPLOT = c("outline=FALSE", "col=color", "xlab=varX", "ylab=varY"))

#Example 3.

F25(data=Z1, varY="M12", varX="Genus", order="alphaAZ",
BOXPLOT = c("notch=TRUE", "col=color", "xlab=varX", "ylab=varY"))

#Example 4.

F25(data=Z1, varY="M12",varX="Genus", order="deacreasing",
BOXPLOT = c("varwidth=TRUE", "col=color", "xlab=varX", "ylab=varY"))

#Example 5.

F25(data=Z1, varY="M12", varX="Genus", jitter=TRUE)

## End(Not run)
```

F26 *BEANPLOTS AND STRIPCHARTS*

Description

It performs beanplots and stripcharts.

Usage

```
F26(data, varY, varX, order=NULL, side="no", beanlines="median", what=c(1,1,1,1),
border="black", ResetPAR=TRUE, PAR=NULL, OrderCat=NULL, LabelCat=NULL,
COLOR=NULL, BEANPLOT=NULL, LEGEND=NULL, AXIS=NULL, MTEXT= NULL, TEXT=NULL)
```

Arguments

`data`	Data file.
`varY`	Dependent variable.
`varX`	Variable with the categories.
`order`	If it is NULL the categories are ordered as found in the variable *varX*, if it is "increasing" are ordered from lesser to greater median or mean according to the method selected in the argument *beanlines*, if it is "decreasing" are ordered from

	greater to lesser median or mean, if it is "alhaAZ" are ordered from A to Z and if it is "alphaZA" from Z to A. If the method selected in *beanlines="quantiles"*, it is used the median for both "increasing" and "decreasing".
`side`	The side on which the beans are plot. Default is "no", for symmetric beans. The options "first", "second" and "both" are also supported.
`beanlines`	The method used for determining the average bean lines. Default is value "median", and other options are "mean" and "quantiles".
`what`	A vector of four booleans describing what to plot. In the following order, these booleans stand for the total average line, the beans, the bean average, and the beanlines. For example, *what=c(0,0,0,1)* produces a stripchart.
`border`	Color of the border around the bean.
`ResetPAR`	If it is FALSE, the default condition of the function PAR is not placed and maintained those defined by the user in previous graphics.
`PAR`	It accesses the function PAR, allowing to modify different aspects of the graph.
`OrderCat`	It allows to specify a vector with the order in which the categories are shown. If this argument is specified, the argument *order* is not taken into account.
`LabelCat`	It allows to specify a vector with the names of the categories.
`COLOR`	Vector with the color of the categories or just one color for all categories.
`BEANPLOT`	It allows to specify the characteristics of the function beanplot.
`LEGEND`	It allows to include a legend to the graph.
`AXIS`	It allows to add axes to the graph.
`MTEXT`	It allows to add text on the margins of the graph.
`TEXT`	It allows to add text in any area of the inner part of the graph.

Details

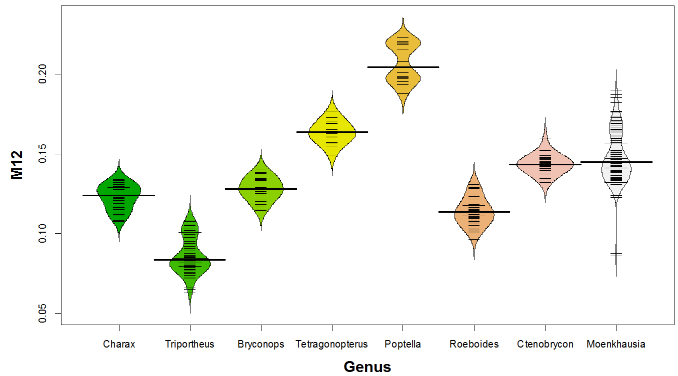
FUNCTIONS

The graph is performed with the function beanplot of the beanplot package (Kampstra, 2008; Kampstra, 2015). For further details see the help of the function beanplot and/or Guisande & Vammonde (2012).

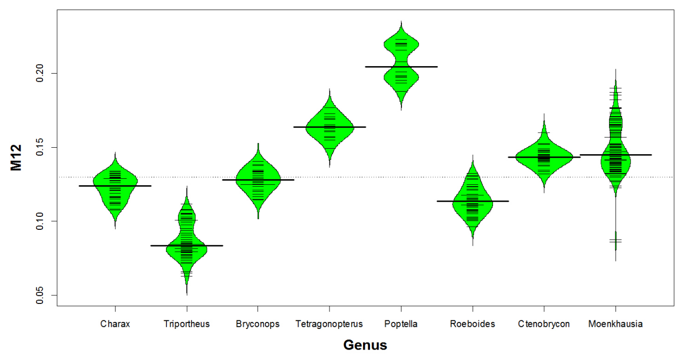
EXAMPLES

For the examples, morphometric data of several fish species of Characiforms, as the length of the dorsal fin base (M12), body height (M11), etc., are used. For details see Guisande et al. (2010). It is shown the length of the dorsal fin base (M12) for all genera.

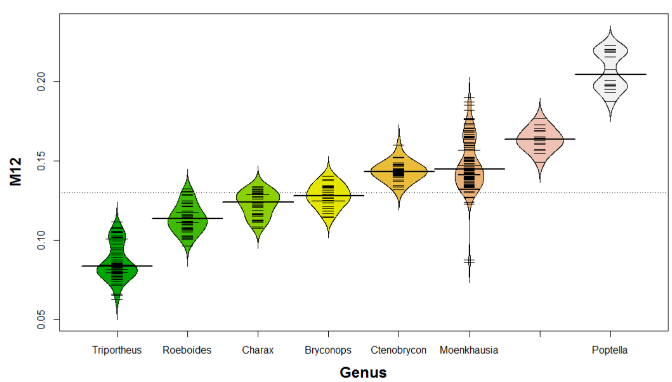
Example 1. Genera are ordered as found in the varX.



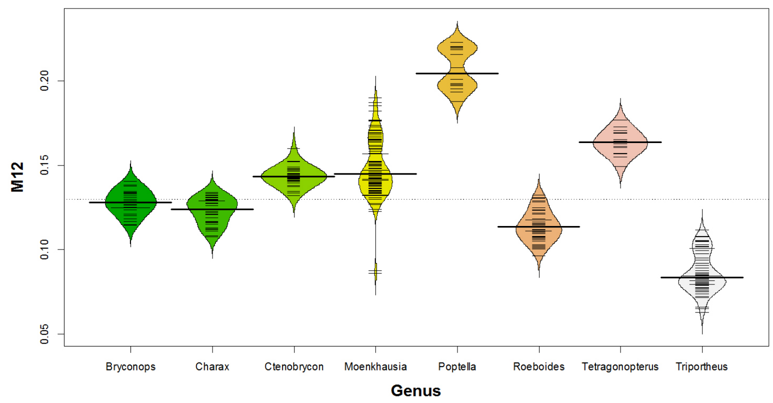
Example 2. One color for all categories just modifying the argument *COLOR="green"*.



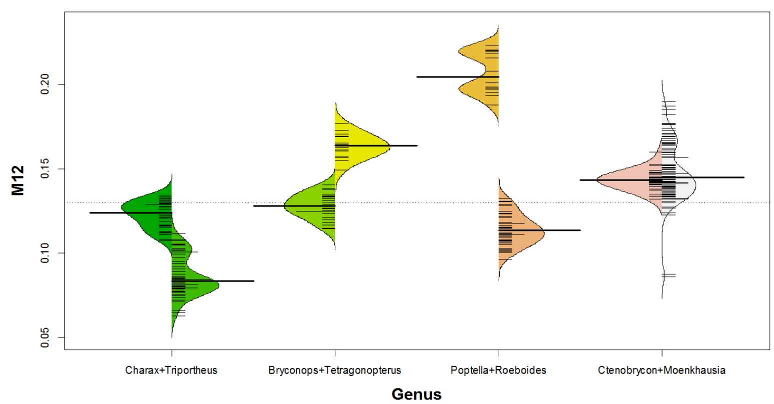
Example 3. Genera are ordered from lesser to greater median with the argument (*order="increasing"*).



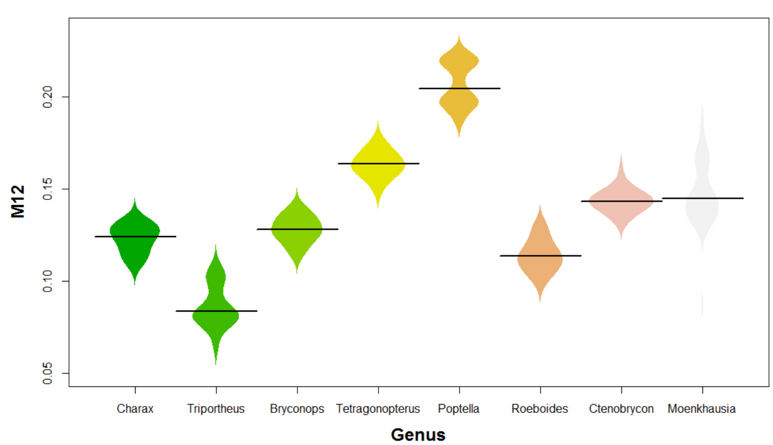
Example 4. Genera are plotted in alphabetical order from A to Z with the argument (*order="alphaAZ"*).



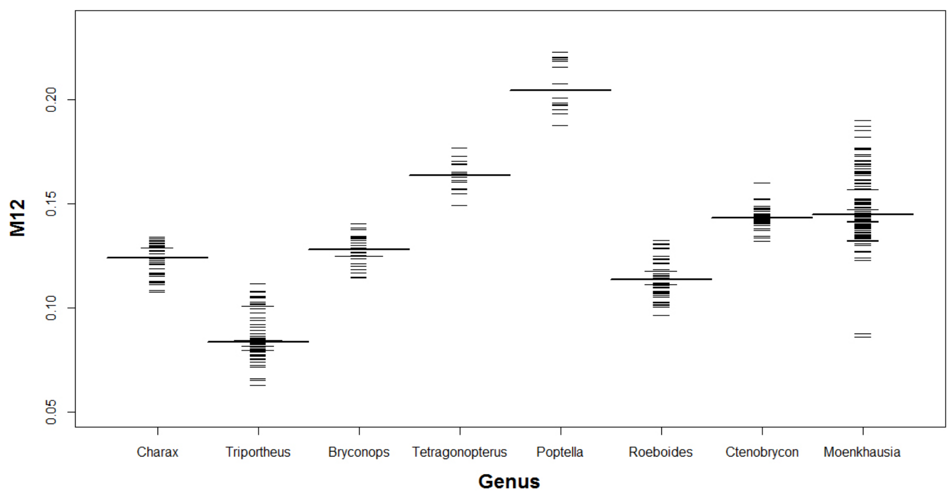
Example 5. Genera are depicted in pairs with the argument (*side="both"*).



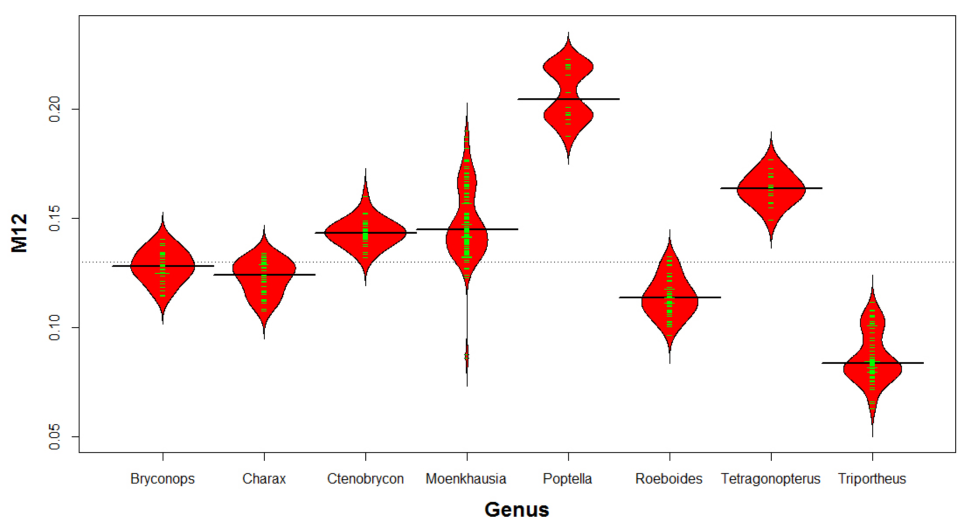
Example 6. Naked beanplots are depicted modifying the argument (*what=c(0,1,1,0)* and *border="transparent"*).



Example 7. A stripchart is depicted modifying the argument (*what=c(0,0,1,1)*).



Example 8. With the argument *BEANPLOT* is possible to access the function beanplot, where the argument *col* is a list with four values: the colors of the area of the beans (without the border, use border for that color), the lines inside the bean, the lines outside the bean and the average line per bean. Therefore, it is possible to modify the color of any of these items, just changing the colors. Moreover, the size of the lines inside the beans, which shows where there are more data within the distribution, it may be modified to a smaller value with the argument *ll=0.05*, which means that the line width is thinner when there is overlap of data.



Value

A beanplot and stripchart plot is obtained.

References

Guisande, C., Manjarrés-Hernández, A., Pelayo-Villamil, P., Granado-Lorencio, C., Riveiro, I., Acuña, A., Prieto-Piraquive, E., Janeiro, E., Matías, J.M., Patti, C., Patti, B., Mazzola, S., Jiménez, S., Duque, V. & Salmerón, F. (2010) IPez: An expert system for the taxonomic identification of fishes based on machine learning techniques. *Fisheries Research*, 102, 240-247.

Guisande, C. & Vaamonde, A. (2012) *Gráficos estadísticos y mapas con R*. Ediciones Díaz de Santos, Madrid, 367 pp.

Kampstra, P (2008). Beanplot: A Boxplot Alternative for Visual Comparison of Distributions. *Journal of Statistical Software, Code Snippets*, 28: 1-9.

Kampstra, P (2015) Visualization via Beanplots (like Boxplot/Stripchart/Violin Plot). R package version 1.2. Available at: https://CRAN.R-project.org/package=beanplot.

Examples

```
## Not run:

data(Z1)

#Example 1.

F26(data=Z1, varY="M12", varX="Genus")

#Example 2.

F26(data=Z1, varY="M12", varX="Genus", COLOR="green")

#Example 3.

F26(data=Z1, varY="M12", varX="Genus", order="increasing")

#Example 4.

F26(data=Z1, varY="M12", varX="Genus", order="alphaAZ")

#Example 5.

F26(data=Z1, varY="M12", varX="Genus", side="both")

#Example 6.

F26(data=Z1, varY="M12", varX="Genus", what=c(0,1,1,0), border="transparent")

#Example 7.

F26(data=Z1, varY="M12", varX="Genus", what=c(0,0,1,1))

#Example 8.

F26(data=Z1, varY="M12", varX="Genus", order="alphaAZ",
BEANPLOT = c("col = list(c('red','green','black','black'))" , "ll=0.05",
```

```
"ylab = varY" , "xlab = varX", "beanlines=beanlines"))

## End(Not run)
```

F27 *GOOGLE GEO MAPS*

Description

A geo map is a map of a country, continent, or region map, with colors and values assigned to specific regions.

Usage

```
F27(data, locationvar, numvar, hovervar, region="world",
showLegend=TRUE, width=1000, height=500, dataMode="regions",
colors=c("#E0FFD400", "#A5EF6300", "#50AA0000", "#26711400"), chartid)
```

Arguments

`data` Data file.

`locationvar` Variable with the geo locations to be analyzed. The locations can be provide in two formats:

Format 1 "latitude:longitude". See the example 1 below.

Format 2 (see example 2 below). Address, country name, region name locations, or US metropolitan area codes. This format works with the dataMode option set to either "markers" or "regions". The following formats are accepted: A specific address (for example, "1600 Pennsylvania Ave"). A country name as a string (for example, "England"), or an uppercase ISO-3166 code or its English text equivalent (for example, "GB" or "United Kingdom"). An uppercase ISO-3166-2 region code name or its English text equivalent (for example, "US-NJ" or "New Jersey").

`numvar` Variable with the numeric value displayed when the user hovers over this region.

`hovervar` Variable with the additional string text displayed when the user hovers over this region.

`region` The area to display on the map (surrounding areas will be displayed as well). Can be either a country code (in uppercase ISO-3166 format), or a one of the following strings described in https://developers.google.com/chart/interactive/docs/gallery/geomap#Configuration_Options:

"world" (Whole world)

"us_metro" (United States, metro areas)

"005" (South America)

"013" (Central America)

"021" (North America)

"002" (All of Africa)

"017" (Central Africa)
"015" (Northern Africa)
"018" (Southern Africa)
"030" (Eastern Asia)
"034" (Southern Asia)
"035" (Asia/Pacific region)
"143" (Central Asia)
"145" (Middle East)
"151" (Northern Asia)
"154" (Northern Europe)
"155" (Western Europe)
"039" (Southern Europe)

`showLegend` If TRUE, display a legend for the map.

`width` Width of the visualization.

`height` Height of the visualization.

`dataMode` How to display values on the map. Two values are supported: "regions" that colors a whole region with the appropriate color, and "markers" that displays a dot over a region, with the color and size indicating the value.

`colors` Color gradient to assign to values in the visualization. You must have at least two values.

`chartid` Character. If missing (default) a random chart id will be generated based on chart type and tempfile.

Details

The plot obtained is shown as a web page, so internet connection is required. This web page may be saved as complete web page and the HTML file obtained may be used, for instance, in a PowerPoint presentation with a hyperlink. For further information see *details* section of the function gvisGeoMap.

FUNCTIONS

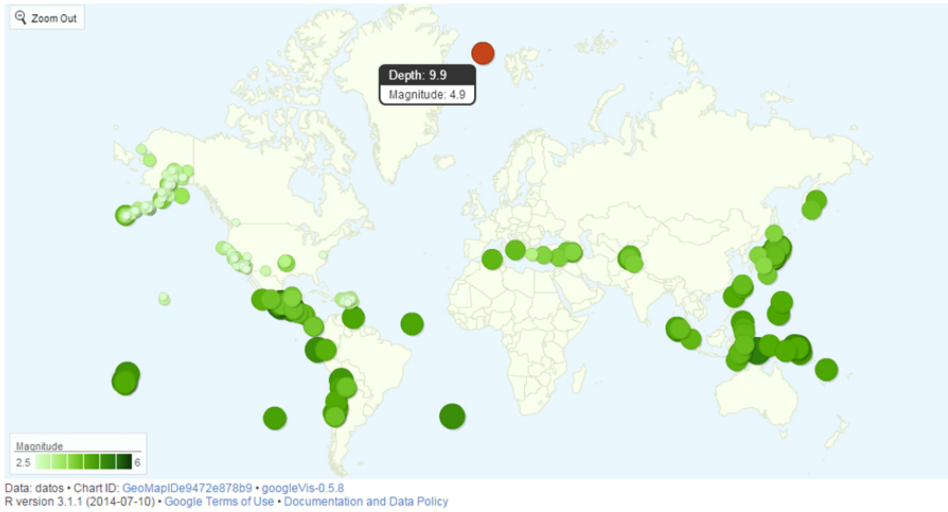
The plot is performed with the function gvisGeoMap of the package googleVis (Gesmann & de Castillo, 2011; 2015). For further details see the help of the function gvisGeoMap and/or Guisande & Vammonde (2012).

EXAMPLES

Example 1

Magnitude and depth of several earthquakes which have happened around the world. The data were obtained from the web site `https://www.usgs.gov/programs/earthquake-hazards/earthquakes`.

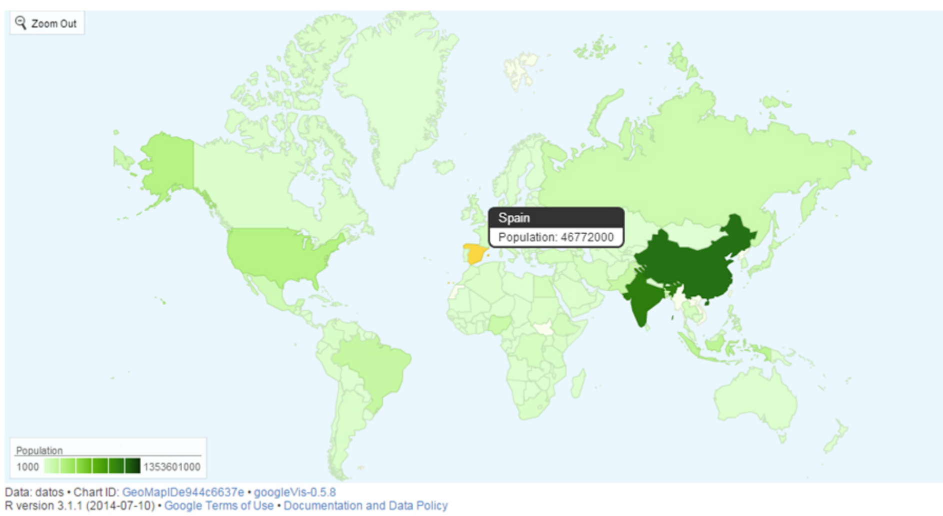
In the example the magnitude of the earthquake is shown in a gradient and the depth in km is displayed when the user hovers over the circle.



Example 2

The data are the population size, growth rate and annual population growth of several countries obtained from the web site world gazetter.

In the example the population size of each country is shown in a gradient, and the country and population size is displayed when the user hovers over the country.



Value

See the value section of the function gvisGeoMap.

References

Gesmann, M. & de Castillo, D. (2011) googleVis: Interface between R and the Google Visualisation API. *The R Journal*, 3(2): 40-44. https://journal.r-project.org/archive/2011-2/

RJournal_2011-2_Gesmann+de~Castillo.pdf.

Gesmann, M. & de Castillo, D. (2015) R Interface to Google Charts. R package version 0.5.8. Available at: https://CRAN.R-project.org/package=googleVis.

Guisande, C. & Vaamonde, A. (2012) *Gráficos estadísticos y mapas con R*. Ediciones Díaz de Santos, Madrid, 367 pp.

Examples

```
## Not run:
#Example 1

data(Z4)

F27(data=Z4, locationvar="LatLong", numvar="Magnitude",
hovervar="Depth", dataMode="markers")

#Example 2

data(Z5)

F27(data=Z5, locationvar="Country", numvar="Population",
hovervar="Country")

## End(Not run)
```

F28 *GOOGLE MOTION CHART*

Description

A motion chart is a dynamic chart to explore several indicators over time.

Usage

```
F28(data, idvar, timevar, xvar, yvar, colorvar="", sizevar="", MOTION=NULL)
```

Arguments

data	Data file.
idvar	Variable with the subject to be analysed.
timevar	Variable which shows the time dimension. The information has to be either numeric, of class Date or a character which follows the pattern "YYYYWww" (e.g. "2010W04" for weekly data) or "YYYYQq" (e.g. "2010Q1" for quarterly data).
xvar	Variable of X-axis.
yvar	Variable of Y-axis.
colorvar	The color is assigned according to this variable.

`sizevar` The size of bubbles is assigned according to this variable.

`MOTION` It accesses the function gvisMotionChart that allows to modify many different aspects of the motion chart.

Details

The plot obtained is shown as a web page, so internet connection is required. For further information see *details* section of the function gvisMotionChart.

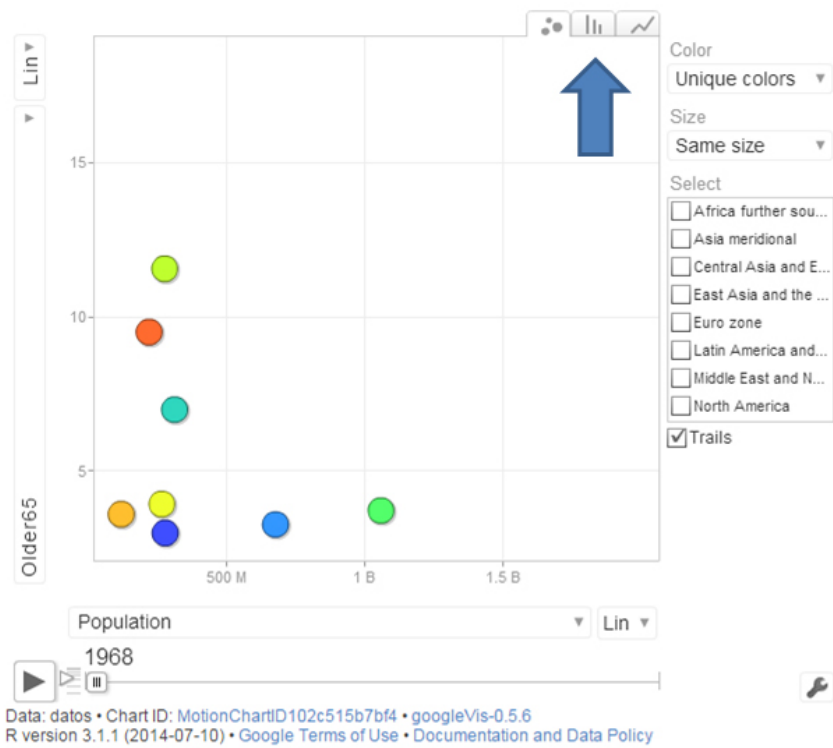
FUNCTIONS

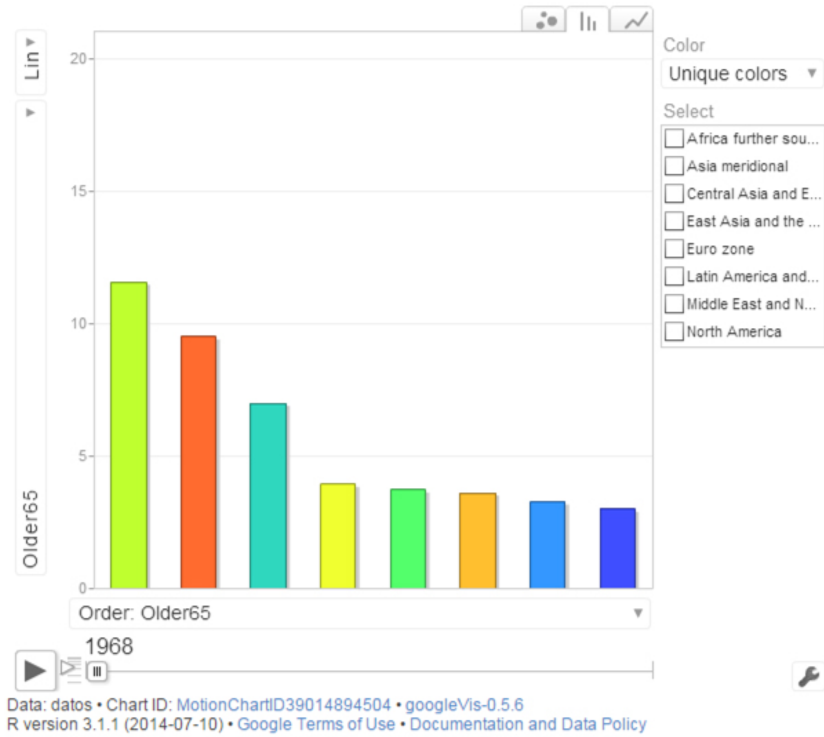
The plot is performed with the function gvisMotionChart of the package googleVis (Gesmann & de Castillo, 2011; 2015). For further details see the help of the function gvisMotionChart and/or Guisande & Vammonde (2012).

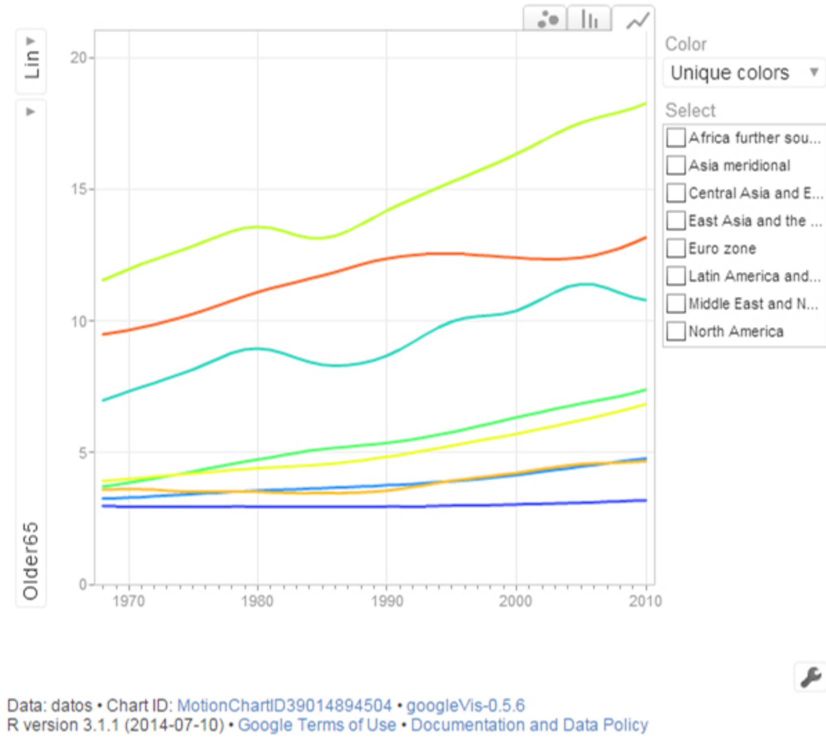
EXAMPLES

Annual demographic parameters from several continents: region, year, percentage of people with an age range from 0 to 14, percentage of people with an age range from 15 to 64, percentage of people older than 65, unemployment older than 65, unemployment younger than 15, growth rate, population size and percentage of women.

The data were obtained from The World Bank (`https://www.worldbank.org/en/home`).




Lin
Older65
20
15
10
5
0
Color
Unique colors
Select
Africa further sou...
Asia meridional
Central Asia and E...
East Asia and the ...
Euro zone
Latin America and...
Middle East and N...
North America
Order: Older65
1968
Data: datos • Chart ID: MotionChartID39014894504 • googleVis-0.5.6
R version 3.1.1 (2014-07-10) • Google Terms of Use • Documentation and Data Policy



In the example, the variables are *idvar = "Region"*, *timevar = "Year"*, *xvar = "Population"* and *yvar = "Older65"*.

The bubble plot, barplot and line plot showed in the above figures may be obtained just clicking on the tabs available on the top right corner of the menu (see blue arrow).

In the case of bubble and bar plots, the animation begins playing when you press the Play button.

Value

See the value section of the function gvisMotionChart.

References

Gesmann, M. & de Castillo, D. (2011) googleVis: Interface between R and the Google Visualisation API. *The R Journal*, 3(2): 40-44. https://journal.r-project.org/archive/2011-2/RJournal_2011-2_Gesmann+de~Castillo.pdf

Gesmann, M. & de Castillo, D. (2015) R Interface to Google Charts. R package version 0.5.8. Available at: https://CRAN.R-project.org/package=googleVis.

Guisande, C. & Vaamonde, A. (2012) *Gráficos estadísticos y mapas con R*. Ediciones Díaz de Santos, Madrid, 367 pp.

Examples

```
## Not run:
```

```
data(Z3)

F28(data=Z3, idvar="Region", timevar="Year", xvar="Population", yvar="Older65")

## End(Not run)
```

F29 *TAYLOR DIAGRAM*

Description

Display a Taylor diagram, which is used to determine the quality of model predictions against the reference values, typically direct observations.

Usage

```
F29(data, ref, models, pos.cor=TRUE, TAYLOR=NULL, ResetPAR=TRUE, PAR=NULL,
COLOR=NULL, PCH=NULL, CEXPCH=1.4, LEGEND=NULL, MTEXT= NULL, TEXT=NULL)
```

Arguments

`data`	Data file.
`ref`	The refrence values, typically observed values.
`models`	The predicted values by the models.
`pos.cor`	Whether to display only positive (TRUE) or all values of correlation (FALSE).
`TAYLOR`	It allows to specify the characteristics of the function taylor.diagram.
`ResetPAR`	If it is FALSE, the default condition of the function PAR is not placed and maintained those defined by the user in previous graphics.
`PAR`	It accesses the function PAR that allows to modify many different aspects of the graph.
`COLOR`	Vector with the color symbol of the models.
`PCH`	Vector with the symbols of the graphic. If NULL, they are automatically calculated starting with the symbol 15.
`CEXPCH`	Size of the graphic symbols.
`LEGEND`	It allows to include a legend to the graph.
`MTEXT`	It allows to add text on the margins of the graph.
`TEXT`	It allows to add text in any area of the inner part of the graph.

Details

This plot allows to select the best model by plotting all models against a reference values (Taylor, 2011), which are typycally the observed values.

Two displays are available. One displays the entire range of correlations from -1 to 1 by setting the argument *pos.cor=FALSE*. When *pos.cor=TRUE*, only the range from 0 to 1 will be displayed.

FUNCTIONS

The plot is performed with the function taylor.diagram of the package plotrix (Lemon et al., 2015). For further details see the help of the function taylor.diagram and/or Guisande & Vammonde (2012).

EXAMPLES

The data are monthly values of temperature and temperature predicted by different models. The aim is to determine which is the best model using the Taylor diagram (Taylor, 2001).

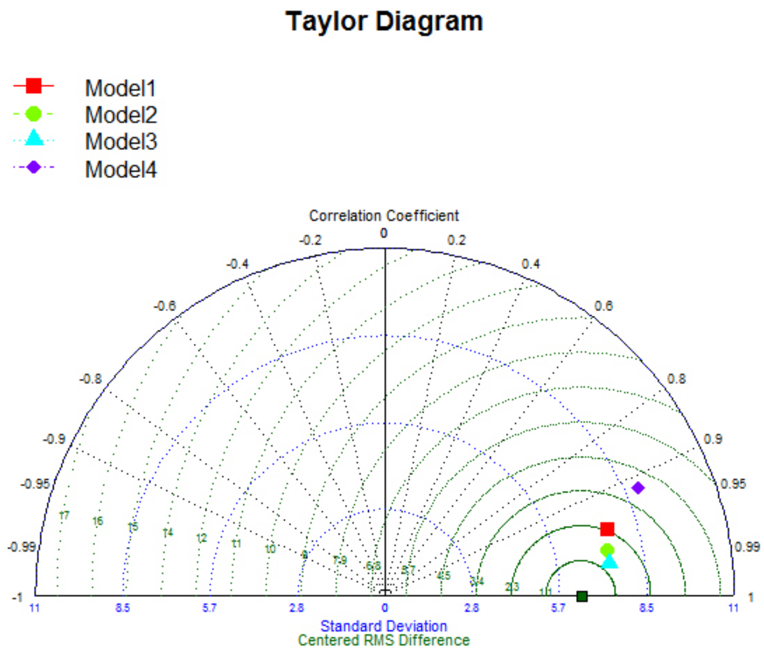
In the Taylor diagram, the models are compared based on correlation coefficient, amplitude variation (standard deviation) and the Root-mean-square error (RMS).

The correlation coefficient is shown in the right graph outer arc (values range from -1 to 1 with the argument *pos.cor=FALSE* and from 0 to 1 with the argument *pos.cor=FALSE*).

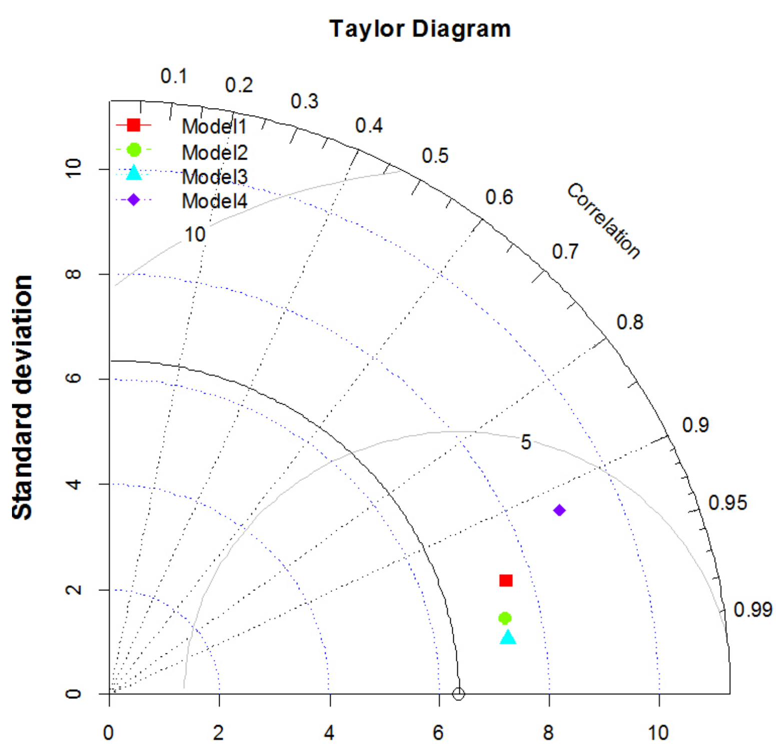
The dotted arcs show the values of the standard deviation (values from 0 to 10 in this example). The arc that is not dotted with an approximate value of 6.35 shows the standard deviation of the observed values and is used as reference. Finally, the arcs with values of 10 and 5, are the RMS.

The best model is the one with a higher coefficient of correlation, a value of RMS smaller and standard deviation closer to the standard deviation of the observed values, which in this example is a line showing a standard deviation of 6.35. Therefore, the model with the blue triangle symbol, model 3, is the most predictive.

Example 1. The first diagram displays the entire range of correlations from -1 to 1 with the argument *pos.cor=FALSE*).



Example 2. The second diagram displays only the range from 0 to 1 (default option).



Value

A Taylor diagram is obtained.

References

Guisande, C. & Vaamonde, A. (2012) *Gráficos estadísticos y mapas con R*. Ediciones Díaz de Santos, Madrid, 367 pp.

Lemon, J., Bolker, B., Oom, S., Klein, E., Rowlingson, B., Wickham, H., Tyagi, A., Eterradossi, O., Grothendieck, G., Toews, M., Kane, J., Turner, R., Witthoft, C., Stander, J., Petzoldt, T., Duursma, R., Biancotto, E., Levy, O., Dutang, C., Solymos, P., Engelmann, R., Hecker, M., Steinbeck, F., Borchers, H., Singmann, H., Toal, T. & Ogle, D. (2015) Various plotting functions. R package version 3.5-11. Available at: https://CRAN.R-project.org/package=plotrix.

Taylor, K.E. (2001) Summarizing multiple aspects of model performance in a single diagram. *Journal of Geophysical Research*, 106: 7183-7192.

Examples

```
## Not run:

data(Z2)

#Example 1.

F29(data=Z2, ref="Observed", models=c("Model1","Model2",
"Model3","Model4"), pos.cor=FALSE)

#Example 2.

F29(data=Z2, ref="Observed", models=c("Model1","Model2","Model3","Model4"))

## End(Not run)
```

F3 *FUNCTION SURFACE PLOTS*

Description

Display a function surface plot.

Usage

```
F3(data, X, Y, func, theta=120, phi=15, ticktype="detailed", PERSP=NULL,
ResetPAR=TRUE, PAR=NULL, XLAB=NULL, YLAB=NULL, ZLAB=NULL, XLIM=NULL,
YLIM=NULL, ZLIM=NULL, COLOR="red", LEGEND=NULL, MTEXT= NULL, TEXT=NULL)
```

Arguments

`data`	Data file.
`X`	Variable X.
`Y`	Variable Y.
`func`	Function of the response surface plot.
`theta`	Angle defining the azimuthal direction.
`phi`	Angle defining the colatitude direction.
`ticktype`	Character: "simple" draws just an arrow parallel to the axis to indicate direction of increase and "detailed" draws normal ticks as per 2D plots.
`PERSP`	It allows to specify the characteristics of the function persp.
`ResetPAR`	If it is FALSE, the default condition of the function PAR is not placed and maintained those defined by the user in previous graphics.
`PAR`	It accesses the function PAR that allows to modify many different aspects of the graph.
`XLAB`	Legend of the X axis.
`YLAB`	Legend of the Y axis.
`ZLAB`	Legend of the Z axis.
`XLIM`	Vector with the limits of the X axis.
`YLIM`	Vector with the limits of the Y axis.
`ZLIM`	Vector with the limits of the Z axis.
`COLOR`	Color of the surface.
`LEGEND`	It allows to include a legend to the graph.
`MTEXT`	It allows to add text on the margins of the graph.
`TEXT`	It allows to add text in any area of the inner part of the graph.

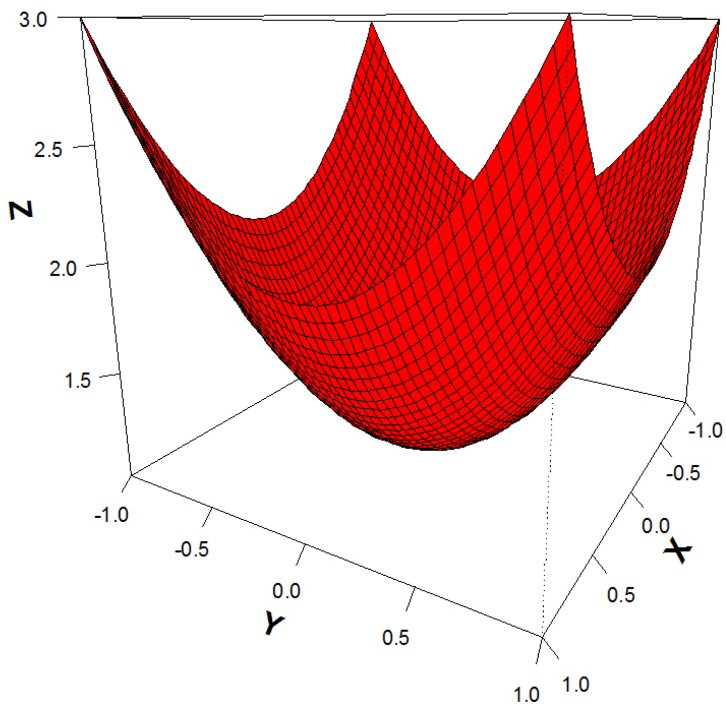
Details

FUNCTIONS

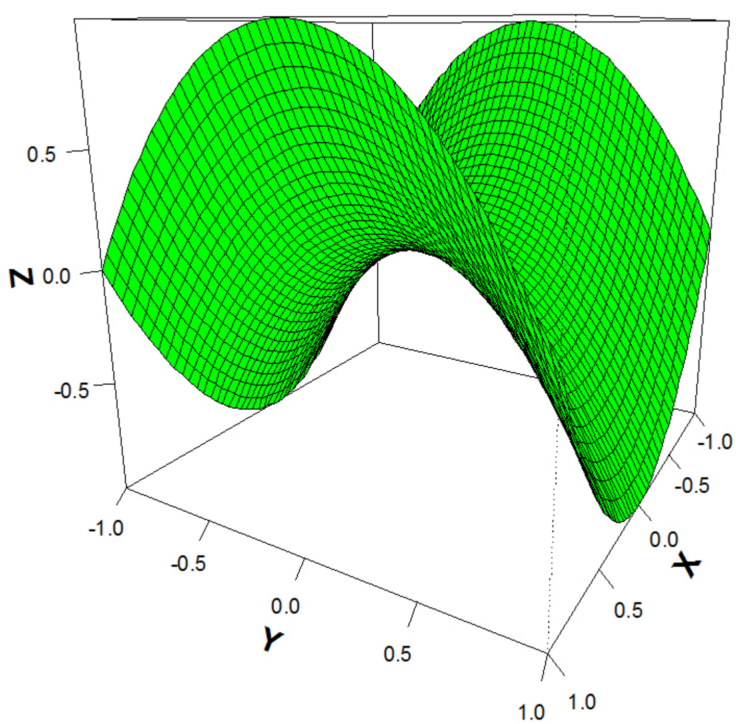
The plot is performed with the function persp of the base package graphics. For further details see the help of the function persp and/or Guisande & Vammonde (2012).

EXAMPLES

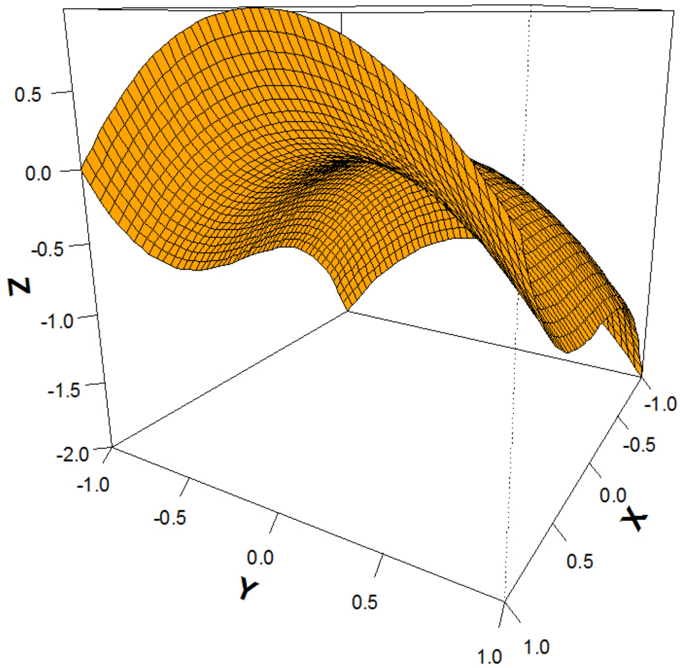
Example 1. Function $x^2 + y^2 + 1$.



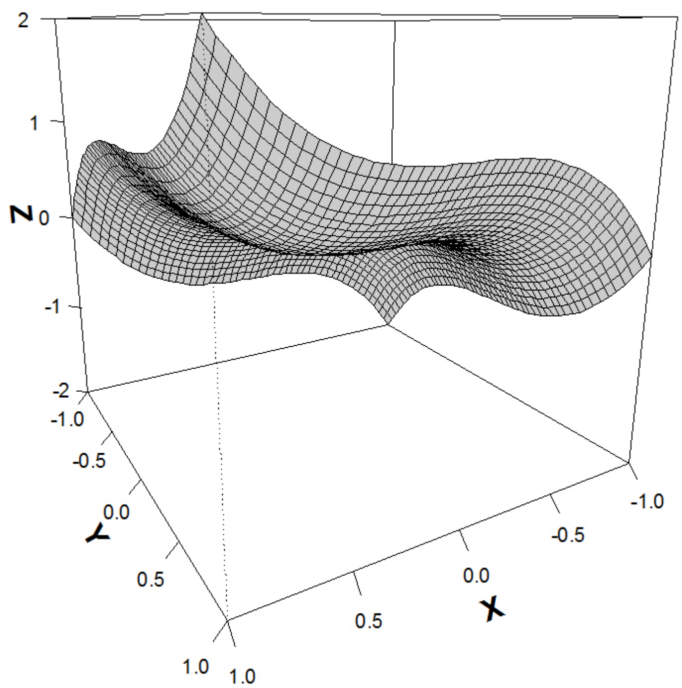
Example 2. Function $x^2 - y^2$.



Example 3. Function $x^3 - y^2$.



Example 4. Function $x^3 + y^3$ and the azimuthal direction is modified with the argument *theta=150*.



Value

A function surface plot is obtained.

References

Guisande, C. & Vaamonde, A. (2012) *Gráficos estadísticos y mapas con R*. Ediciones Díaz de Santos, Madrid, 367 pp.

Examples

```
## Not run:

data(Z9)

#Example 1

F3(data=Z9, X="x", Y="y", func="x^2 + y^2 + 1")

#Example 2

F3(data=Z9, X="x", Y="y", func="x^2 - y^2", COLOR="green")

#Example 3

F3(data=Z9, X="x", Y="y", func="x^3 - y^2", COLOR="orange")

#Example 4

F3(data=Z9, X="x", Y="y", func="x^3 + y^3",  theta=150, COLOR="grey80")

## End(Not run)
```

F30 *3D SURFACE PLOTS*

Description

Display a 3D surface plot.

Usage

```
F30(data, X, Y, Z, matrix=FALSE, theta=120, phi=20, ticktype="detailed",
shade=0.5, scale=TRUE, PERSP=NULL, ResetPAR=TRUE, PAR=NULL, XLAB=NULL,
YLAB=NULL, ZLAB=NULL, XLIM=NULL, YLIM=NULL, ZLIM=NULL, COLOR="white",
LEGEND=NULL, MTEXT= NULL, TEXT=NULL)
```

Arguments

`data`	Data file.
`X`	Variable X.
`Y`	Variable Y.
`Z`	Variable Z.
`matrix`	If it is TRUE the variable Z has the format of a matrix and if it is FALSE (default) the variable Z has the format of a column.
`theta`	Angle defining the azimuthal direction.
`phi`	Angle defining the colatitude direction.
`ticktype`	Character: "simple" draws just an arrow parallel to the axis to indicate direction of increase and "detailed" draws normal ticks as per 2D plots.
`shade`	Values of shade close to one yield shading similar to a point light source model and values close to zero produce no shading. Values in the range 0.5 to 0.75 provide an approximation to daylight illumination.
`scale`	If it is TRUE the X, Y and Z variables are transformed separately. If scale is FALSE the coordinates are scaled so that aspect ratios are retained.
`PERSP`	It allows to specify the characteristics of the function persp.
`ResetPAR`	If it is FALSE, the default condition of the function PAR is not placed and maintained those defined by the user in previous graphics.
`PAR`	It accesses the function PAR that allows to modify many different aspects of the graph.
`XLAB`	Legend of the X axis.
`YLAB`	Legend of the Y axis.
`ZLAB`	Legend of the Z axis.
`XLIM`	Vector with the limits of the X axis.
`YLIM`	Vector with the limits of the Y axis.
`ZLIM`	Vector with the limits of the Z axis.
`COLOR`	Color of the surface.
`LEGEND`	It allows to include a legend to the graph.
`MTEXT`	It allows to add text on the margins of the graph.
`TEXT`	It allows to add text in any area of the inner part of the graph.

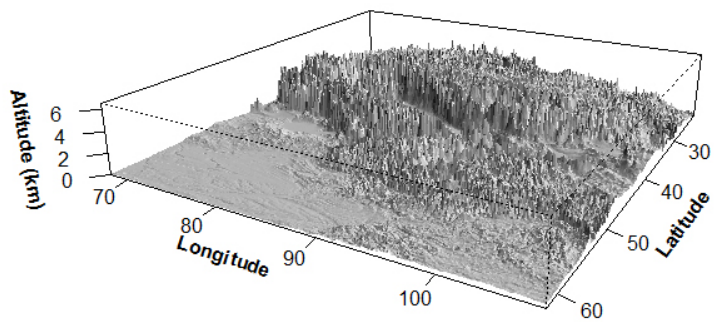
Details

FUNCTIONS

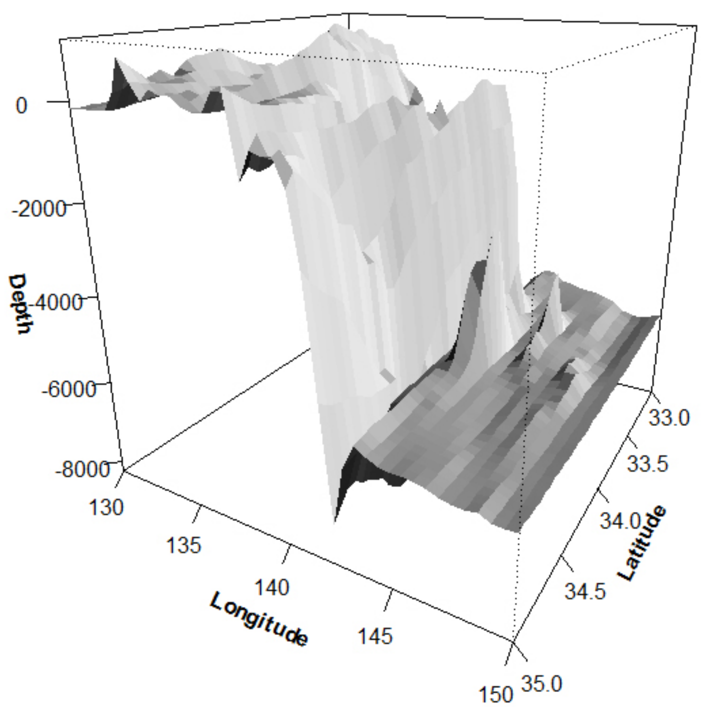
The plot is performed with the function persp of the base package graphics. In the case of the variable Z with a column format, the matrix is obtained using the function interp of the package akima (Akima et al., 2015). For further details see the help of the functions persp, link[akima]interp and/or Guisande & Vammonde (2012).

EXAMPLES

Example 1. Altitude in the Himalayan region, with the altitude (variable Z) in a matrix format.



Example 2. Depth in a coastal area close to Japan, with the depth (variable Z) in a column format (argument *matrix=TRUE*).



Value

A 3D surface plot is obtained.

References

Akima, H., Gebhardt, A., Petzoldt, T & Maechler, M. (2015) Interpolation of irregularly spaced data. R package version 0.5-11. Available at: https://CRAN.R-project.org/package=akima.

Guisande, C. & Vaamonde, A. (2012) *Gráficos estadísticos y mapas con R*. Ediciones Díaz de Santos, Madrid, 367 pp.

Examples

```
## Not run:

#Example 1

data(Z10)

F30(data=Z10, X="Latitude", Y="Longitude", Z=c("Z1","Z2","Z3", "Z4","Z5","Z6",
"Z7","Z8","Z9","Z10","Z11","Z12","Z13","Z14","Z15","Z16","Z17","Z18","Z19","Z20",
"Z21","Z22","Z23","Z24","Z25","Z26","Z27","Z28","Z29","Z30","Z31","Z32","Z33",
"Z34","Z35","Z36","Z37","Z38","Z39","Z40","Z41","Z42","Z43","Z44","Z45","Z46",
"Z47","Z48","Z49","Z50","Z51","Z52","Z53","Z54","Z55","Z56","Z57","Z58","Z59",
"Z60","Z61","Z62","Z63","Z64","Z65","Z66","Z67","Z68","Z69","Z70","Z71","Z72",
"Z73","Z74","Z75","Z76","Z77","Z78","Z79","Z80","Z81","Z82","Z83","Z84","Z85",
"Z86","Z87","Z88","Z89","Z90","Z91","Z92","Z93","Z94","Z95","Z96","Z97","Z98",
"Z99","Z100","Z101","Z102","Z103","Z104","Z105","Z106","Z107","Z108","Z109",
"Z110","Z111","Z112","Z113","Z114","Z115","Z116","Z117","Z118","Z119","Z120",
"Z121","Z122","Z123","Z124","Z125","Z126","Z127","Z128","Z129","Z130","Z131",
"Z132","Z133","Z134","Z135","Z136","Z137","Z138","Z139","Z140","Z141","Z142",
"Z143","Z144","Z145","Z146","Z147","Z148","Z149","Z150","Z151","Z152","Z153",
"Z154","Z155","Z156","Z157","Z158","Z159","Z160","Z161","Z162","Z163","Z164",
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"Z187","Z188","Z189","Z190","Z191","Z192","Z193","Z194","Z195","Z196","Z197",
"Z198","Z199","Z200","Z201","Z202","Z203","Z204","Z205","Z206","Z207","Z208",
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"Z220","Z221","Z222","Z223","Z224","Z225","Z226","Z227","Z228","Z229","Z230",
"Z231","Z232","Z233","Z234","Z235","Z236","Z237","Z238","Z239","Z240","Z241",
"Z242","Z243","Z244","Z245","Z246","Z247","Z248","Z249","Z250","Z251","Z252",
"Z253","Z254","Z255","Z256","Z257","Z258","Z259","Z260","Z261","Z262","Z263",
"Z264","Z265","Z266","Z267","Z268","Z269","Z270","Z271","Z272","Z273","Z274",
"Z275","Z276","Z277","Z278","Z279","Z280","Z281","Z282","Z283","Z284","Z285",
"Z286","Z287","Z288","Z289","Z290","Z291","Z292","Z293","Z294","Z295","Z296",
"Z297","Z298","Z299","Z300","Z301","Z302","Z303","Z304","Z305","Z306","Z307",
"Z308","Z309","Z310","Z311","Z312","Z313","Z314","Z315","Z316","Z317","Z318",
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"Z330","Z331","Z332","Z333","Z334","Z335","Z336","Z337","Z338","Z339","Z340",
"Z341","Z342","Z343","Z344","Z345","Z346","Z347","Z348","Z349","Z350","Z351",
"Z352","Z353","Z354","Z355","Z356","Z357","Z358","Z359","Z360","Z361","Z362",
"Z363","Z364","Z365","Z366","Z367","Z368","Z369","Z370","Z371","Z372","Z373",
"Z374","Z375","Z376","Z377","Z378","Z379","Z380","Z381","Z382","Z383","Z384",
"Z385","Z386","Z387","Z388","Z389","Z390","Z391","Z392","Z393","Z394","Z395",
"Z396","Z397","Z398","Z399","Z400","Z401","Z402","Z403","Z404","Z405","Z406",
"Z407","Z408","Z409","Z410","Z411","Z412","Z413","Z414","Z415","Z416","Z417",
"Z418","Z419","Z420","Z421","Z422","Z423","Z424","Z425","Z426","Z427","Z428",
"Z429","Z430","Z431","Z432","Z433","Z434","Z435","Z436","Z437","Z438","Z439",
"Z440","Z441","Z442","Z443","Z444","Z445","Z446","Z447","Z448","Z449","Z450",
"Z451","Z452","Z453","Z454","Z455","Z456","Z457","Z458","Z459","Z460","Z461",
"Z462","Z463","Z464","Z465","Z466","Z467","Z468","Z469","Z470","Z471","Z472",
```

```
"Z473","Z474","Z475","Z476","Z477","Z478","Z479","Z480","Z481"),
matrix=TRUE, scale=FALSE, ZLAB="Altitude (km)")

#Example 2

data(Z11)

F30(data=Z11, X="Latitude", Y="Longitude", Z="Depth", shade=1)

## End(Not run)
```

F31 *3D SURFACE GRADIENT PLOTS*

Description

Display a 3D surface gradient plot with variable Z as a column.

Usage

```
F31(data, X, Y, Z, theta=120, phi=20, ticktype="detailed", scale=TRUE,
type="mgcv", DPLOT=NULL, ResetPAR=TRUE, PAR=NULL, XLAB=NULL, YLAB=NULL,
ZLAB=NULL, XLIM=NULL, YLIM=NULL, ZLIM=NULL, COLOR=rainbow, LEGEND=NULL,
MTEXT= NULL, TEXT=NULL)
```

Arguments

`data`	Data file.
`X`	Variable X.
`Y`	Variable Y.
`Z`	Variable Z.
`theta`	Angle defining the azimuthal direction.
`phi`	Angle defining the colatitude direction.
`ticktype`	Character: "simple" draws just an arrow parallel to the axis to indicate direction of increase and "detailed" draws normal ticks as per 2D plots.
`scale`	If it is TRUE the X, Y and Z variables are transformed separately. If scale is FALSE the coordinates are scaled so that aspect ratios are retained.
`type`	Type of interpolation method. The options are "akima", "mba" and "mgcv". For details see the same argument of the plot3d.
`DPLOT`	It allows to specify the characteristics of the function plot3d.
`ResetPAR`	If it is FALSE, the default condition of the function PAR is not placed and maintained those defined by the user in previous graphics.
`PAR`	It accesses the function PAR that allows to modify many different aspects of the graph.

XLAB	Legend of the X axis.
YLAB	Legend of the Y axis.
ZLAB	Legend of the Z axis.
XLIM	Vector with the limits of the X axis.
YLIM	Vector with the limits of the Y axis.
ZLIM	Vector with the limits of the Z axis.
COLOR	Color of the surface.
LEGEND	It allows to include a legend to the graph.
MTEXT	It allows to add text on the margins of the graph.
TEXT	It allows to add text in any area of the inner part of the graph.

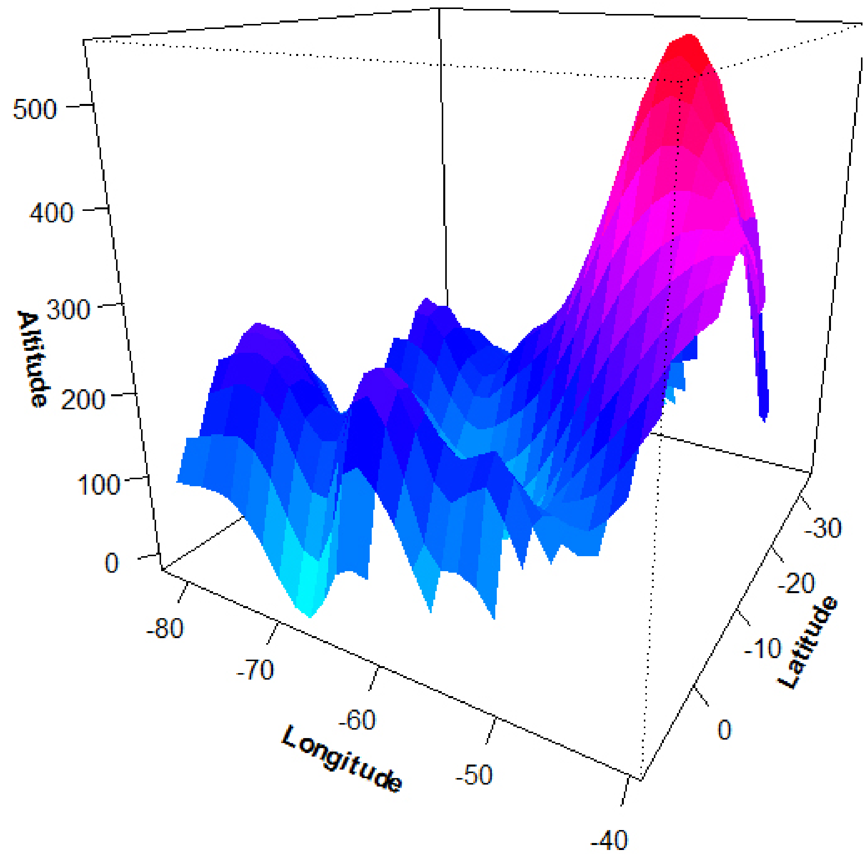
Details

FUNCTIONS

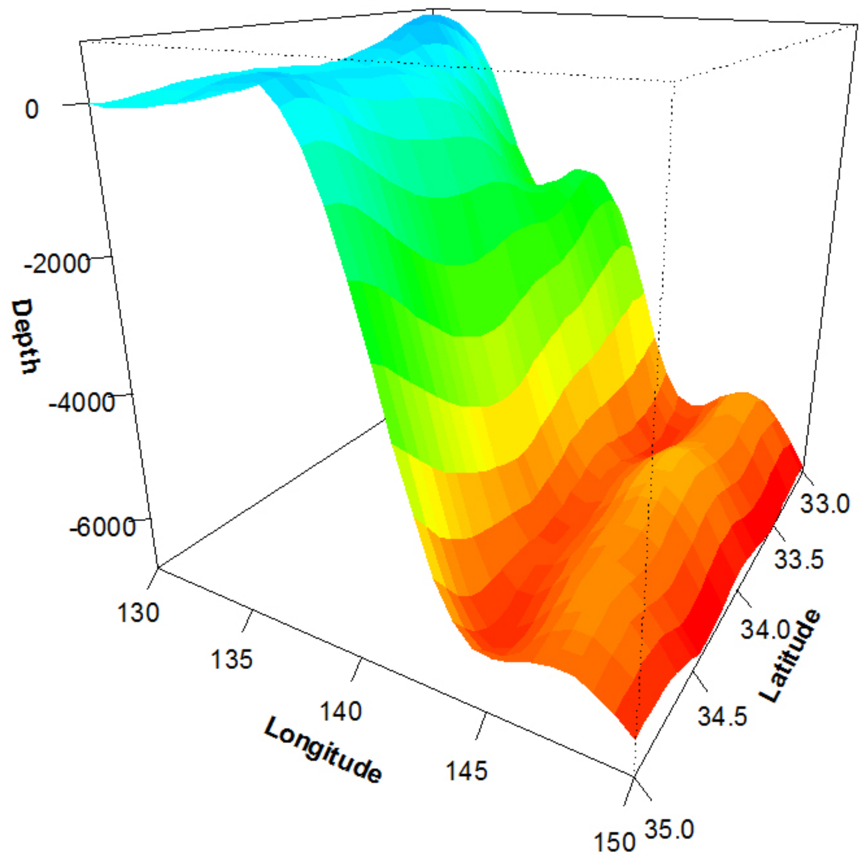
The plot is performed with the function plot3d of the base package graphics R2BayesX (Umlauf et al., 2015a; 2015b).

EXAMPLES

Example 1. Geographical records and altitude of fish freshwater species of the genus Cyphocharax.



Example 2. Depth in a coastal area close to Japan.



Value

A 3D surface gradient plot is obtained.

References

Umlauf, N., Adler, D., Kneib, T., Lang, S., Zeileis, A. (2015a). Structured Additive Regression Models: An R Interface to BayesX. *Journal of Statistical Software*, 63(21), 1-46. https://www.jstatsoft.org/v63/i21/.

Umlauf, N., Kneib, T., Lang, S. & Zeileis, A.(2015b) Estimate Structured Additive Regression Models with BayesX. R package version 1.0-0. Available at: https://CRAN.R-project.org/package=R2BayesX.

Examples

```
## Not run:

#Example 1

data(Z12)
```

```
F31(data=Z12, X="Latitude", Y="Longitude", Z="Altitude")

#Example 2

data(Z11)

F31(data=Z11, X="Latitude", Y="Longitude", Z="Depth")

## End(Not run)
```

F32 *LINE CHARTS FOR VARIABLE X QUANTITATIVE*

Description

It performs a simple line chart with or without text labels and a regression model.

Usage

```
F32(data, varY,  varX, textlabel=NULL, type="b", label=NULL, reg=FALSE,
model="Linear", outliers=FALSE, quant1=0.05, quant2 = 0.95,  ci=TRUE,
level=0.95, ResetPAR=TRUE, PAR=NULL, XLAB=NULL, YLAB=NULL, COLOR="black",
COLORR="red", PCH=16, lty=1, ltyci=2,  ltyL=1, lwd=2.5, lwdL=1, R2.pos="topleft",
PLOT=NULL, LEGEND=NULL, AXIS=NULL, MTEXT= NULL, TEXT=NULL,
dec=",", file="Output.txt")
```

Arguments

`data`	Data file.
`varY`	Dependent variable.
`varX`	Quantitative independent variable.
`textlabel`	Variable with the text labels.
`type`	Character string giving the type of plot desired. The following values are possible: "p" for points, "l" for lines, "b" for both points and lines, "c" for empty points joined by lines, "o" for overplotted points and lines, "s" and "S" for stair steps and "h" for histogram-like vertical lines. Finally, "n" does not produce any points or lines.
`label`	It allows to specify the characteristics of the text labels with the function text.
`reg`	If TRUE a regression model is performed.
`model`	One regression model can be selected: "Linear" , "Log", "S-curve", "Power", "Exp", "Quadratic", "Cubic", "Inverse". It is not considered the model in those cases in which there is the logarithm that apply to any of the variables, if any value of the variable, which applies the logarithm, is zero or negative. The inverse model is not calculated if any value of the independent variable is zero.
`outliers`	If it is TRUE, the outliers are removed using the selected regression model.

quant1	Quantile of the lower end to the elimination of outliers.
quant2	Quantile of the upper end to the elimination of outliers.
ci	If it is TRUE the confidence interval is depicted, but only for the linear regression model.
level	Tolerance/confidence level.
ResetPAR	If it is FALSE, the default condition of the function PAR is not placed and maintained those defined by the user in previous graphics.
PAR	It accesses the function PAR that allows to modify many different aspects of the graph.
XLAB	Legend of the X axis.
YLAB	Legend of the Y axis.
COLOR	Color of the symbols.
COLORR	Color of the line of the regression model.
PCH	Graphic symbol (see the description of the same argument in the function F1).
lty	Type of the regression line (see the description of the same argument in the function F1).
ltyci	Type of the confidence interval line (see figure of the argument *lty* in the function F1).
ltyL	Type of the line chart (see figure of the argument *lty* in the function F1).
lwd	Line width of the regression line relative to the default (default=1), so 2 is twice as wide.
lwdL	Line width of the chart relative to the default (default=1), so 2 is twice as wide.
R2.pos	If it is not NULL, with this argument is possible to specify the position of the r^2 of the regression in the scatter plot.
PLOT	It allows to specify the characteristics of the function plot.default.
LEGEND	It allows to include a legend to the graph.
AXIS	It allows to add axes to the graph.
MTEXT	It allows to add text on the margins of the graph.
TEXT	It allows to add text in any area of the inner part of the graph.
dec	It defines if the comma "," is used as decimal separator or the dot ".".
file	TXT FILE. If the argument *reg=TRUE* a TXT file is saved with the information of the regression.

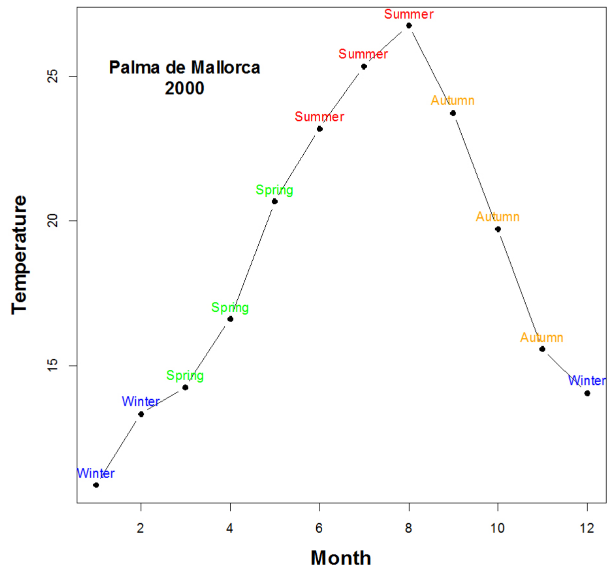
Details

FUNCTIONS

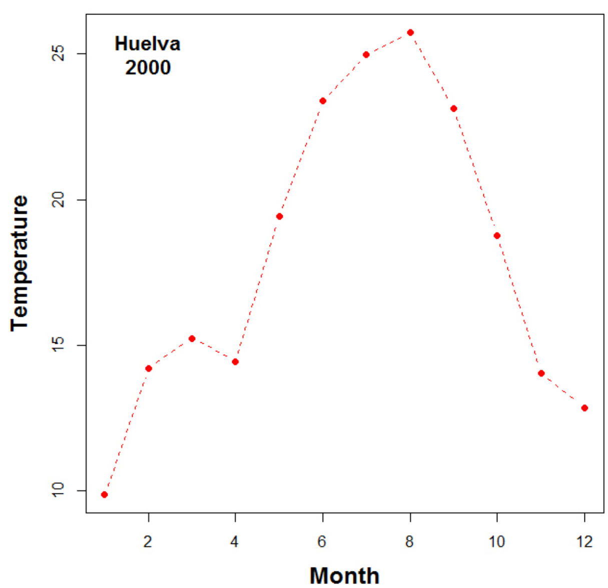
The plot is performed with the function plot.default of base graphics package and the linear regression with the function lm of base stats package. The function lillie.test of the package nortest (Gross, 2013) is used to perform the test of Normality Kolmogorov-Smirnov with Lilliefors'correction, the function dwtest of the package lmtest (Hothorn et al., 2013) to analyze the autocorrelation with the test and the Durbin-Watson statistic function bptest of the package lmtest (Hothorn et al., 2013) to perform the Breusch-Pagan test of homoscedasticity.

EXAMPLES The data are monthly mean temperature for 1990 and 2000 in three cities in Spain: Huelva, Palma de Mallorca and Vigo. They were obtained from the Agencia Estatal de Meteorología of Spain https://www.aemet.es/es/portada.

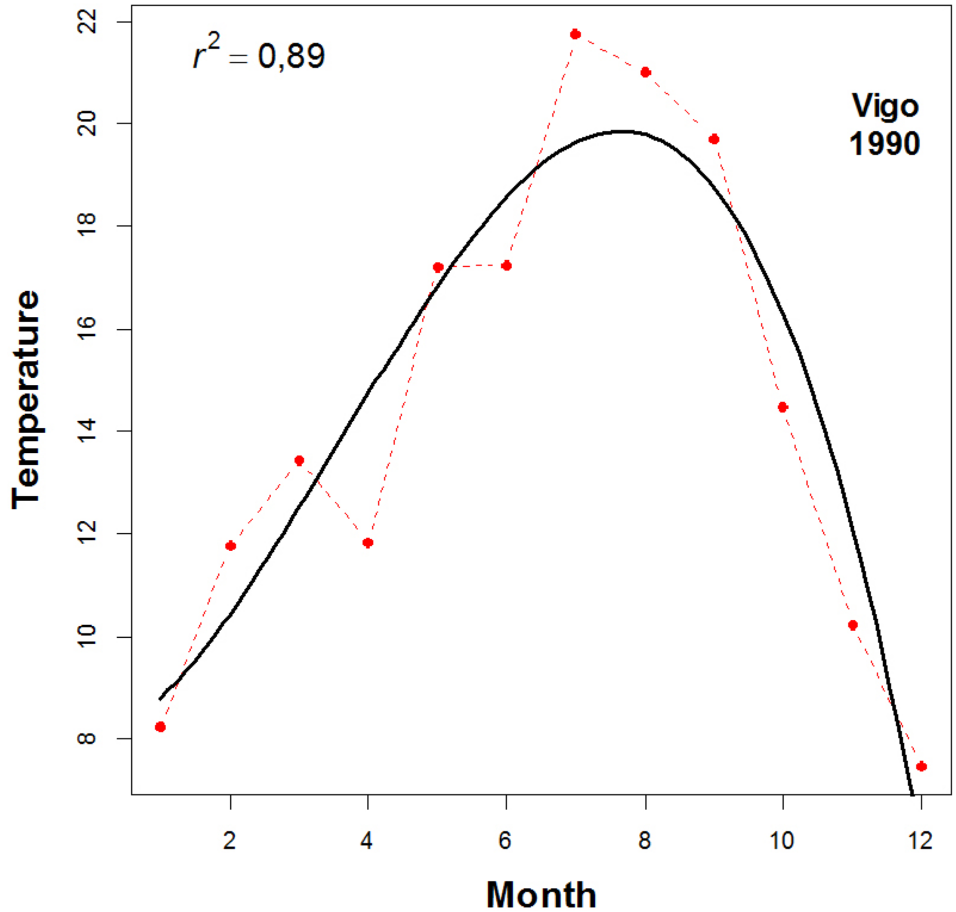
Example 1 Monthly temperature in Palma de Mallorca in the year 2000. Text labels are assigned to the points with the argument *textlabel="Season"*. Moreover, a different color is assigned to each text label using a variable with colors.



Example 2 Monthly temperature in Huelva in the year 2000 without text labels.



Example 3 A linear regression line is added with the argument *reg=TRUE*.



Value

A simple line chart with or without linear regression is obtained.

References

Durbin, J. & Watson G.S. (1951) Testing for serial correlation in least squares regression. *Biometrika*, **38**, 159-171.

Gross, J. (2013) Tests for Normality. R package version 1.0-2. Available at: https://CRAN.R-project.org/package=nortest.

Hothorn, T. et al., (2013) Testing Linear Regression Models. R package version 0.9-33. Available at: https://CRAN.R-project.org/package=lmtest.

Examples

```
## Not run:

#Example 1
```

```
data(Z13)

data<-subset(Z13,(City == "Palma de Mallorca") &  (Year == 2000))

color<-as.character(data[,"Color"])

F32(data=data, varY="Temperature", varX="Month", textlabel="Season",
label = c("pos = 3" , "col = color"), TEXT = c("x = 3" , "y=25",
"labels = 'Palma de Mallorca\n2000'", "font=2", "cex=1.3"))

#Example 2

data(Z13)

data<-subset(Z13,(City == "Huelva") &  (Year == 2000))

F32(data=data, varY="Temperature", varX="Month", COLOR="red", ltyL=2,
TEXT = c("x = 2" , "y=25", "labels = 'Huelva\n2000'", "font=2", "cex=1.3"))

#Example 3

data(Z13)

data<-subset(Z13,(City == "Vigo") &  (Year == 1990))

F32(data=data, varY="Temperature", varX="Month", reg=TRUE, model="Cubic",
COLOR="red", COLORR="black", ltyL=2, TEXT=c("x=11.5", "y=20", "labels = 'Vigo\n1990'",
"font=2", "cex=1.3"))

## End(Not run)
```

F33 *SIMPLE LINE CHARTS WITH ERROR BARS, TEXT LABELS AND REGRESSION FOR VARIABLE X QUANTITATIVE*

Description

It performs a simple mean with error bars line chart for variable X quantitative with text labels and a regression model.

Usage

```
F33(data, varY,  varX, Factor, method="mean", type="b", dev="sd", barY=TRUE,
barX=FALSE, textlabel=FALSE, label=NULL, reg=FALSE, model="Linear",
outliers=FALSE, quant1=0.05, quant2 = 0.95, ResetPAR=TRUE, PAR=NULL, XLAB=NULL,
YLAB=NULL, XLIM=NULL, YLIM=NULL,  COLOR="black", COLORI="black", COLORR="red",
PCH=16, lty=3, ltyL=1, lwd=2.5, lwdL=1, R2.pos="topleft", PLOT=NULL,
LEGEND=NULL, AXIS=NULL, MTEXT= NULL, TEXT=NULL, file1="Output.txt",
file2="Average and error bars.csv", na="NA", dec=",", row.names=FALSE)
```

Arguments

`data`	Data file.
`varY`	Dependent variable.
`varX`	Quantitative independent variable.
`Factor`	Variable for the estimation of the average and error bars for each category of the variable. It is not possible to include variables with any of the categories with a single data, so if necessary several data for each category.
`method`	The average of each category of the grouped variable *Factor* is estimated with the "mean" or the "median".
`type`	Character string giving the type of plot desired. The following values are possible: "p" for points, "l" for lines, "b" for both points and lines, "c" for empty points joined by lines, "o" for overplotted points and lines, "s" and "S" for stair steps and "h" for histogram-like vertical lines. Finally, "n" does not produce any points or lines.
`dev`	The error bars may be estimated using the standard deviation ("sd") or the standard error ("se").
`barY`	If it is TRUE the bar error of the variable Y is depicted.
`barX`	If it is TRUE the bar error of the variable X is depicted.
`textlabel`	If TRUE the text labels of the categories of the variable *Factor* are added to the plot.
`label`	It allows to specify the characteristics of the text labels with the function text.
`reg`	If it is TRUE a regression model is performed.
`model`	One regression model can be selected: "Linear" , "Log", "S-curve", "Power", "Exp", "Quadratic", "Cubic", "Inverse". It is not considered the model in those cases in which there is the logarithm that apply to any of the variables, if any value of the variable, which applies the logarithm, is zero or negative. The inverse model is not calculated if any value of the independent variable is zero.
`outliers`	If it is TRUE, the outliers are removed using the selected regression model.
`quant1`	Quantile of the lower end to the elimination of outliers.
`quant2`	Quantile of the upper end to the elimination of outliers.
`ResetPAR`	If it is FALSE, the default condition of the function PAR is not placed and maintained those defined by the user in previous graphics.
`PAR`	It accesses the function PAR that allows to modify many different aspects of the graph.
`XLAB`	Legend of the X axis.
`YLAB`	Legend of the Y axis.
`XLIM`	Vector with the limits of the X axis.
`YLIM`	Vector with the limits of the Y axis.
`COLOR`	Color of the symbols.
`COLORI`	Color of the error bars.

`COLORR`	Color of the line of the regression model.
`PCH`	Graphic symbol (see the description of the same argument in the function F1).
`lty`	Type of the regression line (see the description of the same argument in the function F1).
`ltyL`	Type of the line chart (see figure of the argument *lty* in the function F1).
`lwd`	Line width of the regression line relative to the default (default=1), so 2 is twice as wide.
`lwdL`	Line width of the chart relative to the default (default=1), so 2 is twice as wide.
`R2.pos`	If it is not NULL, with this argument is possible to specify the position of the r^2 of the regression in the scatter plot.
`PLOT`	It allows to specify the characteristics of the function plot.default.
`LEGEND`	It allows to include a legend to the graph.
`AXIS`	It allows to add axes to the graph.
`MTEXT`	It allows to add text on the margins of the graph.
`TEXT`	It allows to add text in any area of the inner part of the graph.
`file1`	TXT FILE. If the argument *reg=TRUE* a TXT file is saved with the information of the regression.
`file2`	CSV FILE. File name with the mean, median, standard error and standard deviation for each category of the variable *Factor*.
`na`	CSV FILES. Text that is used in the cells without data.
`dec`	CSV FILES. It defines if the comma "," is used as decimal separator or the dot ".".
`row.names`	CSV FILES. Logical value that defines if identifiers are put in rows or a vector with a text for each of the rows.

Details

See the equations of all regression models in the section *details* of the function XI1 of the package StatR.

FUNCTIONS

The plot is performed with the function plot.default of base graphics package

The linear regression with the function lm of base stats package.

The function lillie.test of the package nortest (Gross, 2013) is used to perform the test of Normality Kolmogorov-Smirnov with Lilliefors'correction

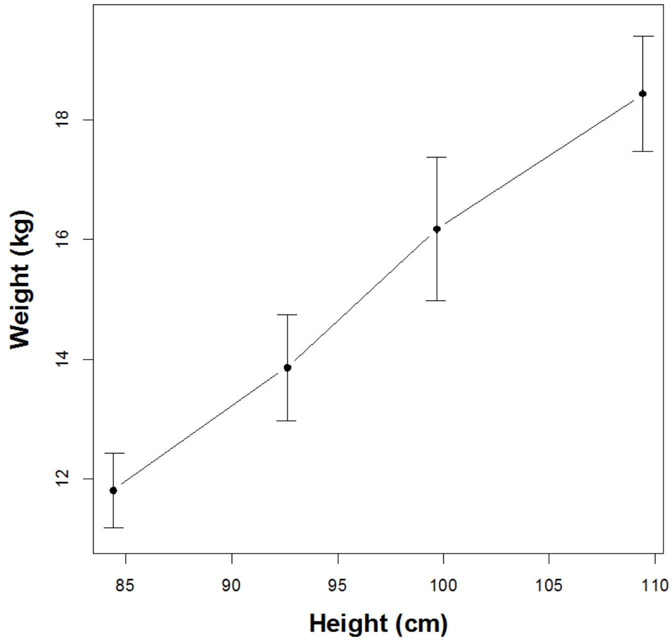
The function dwtest of the package lmtest (Hothorn et al., 2013) to analyze the autocorrelation with the test

The Durbin-Watson statistic function bptest of the package lmtest (Hothorn et al., 2013) to perform the Breusch-Pagan test of homoscedasticity.

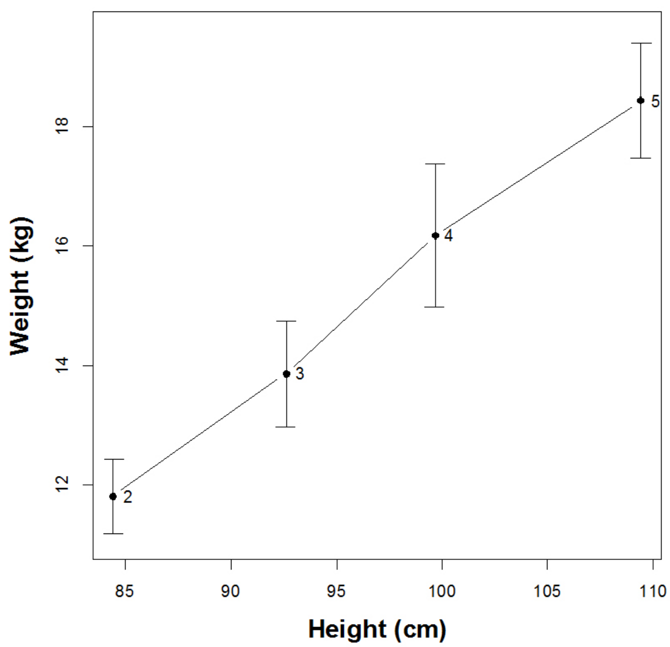
EXAMPLES

For the examples, weight and height of chidren aged 2-5 years are used.

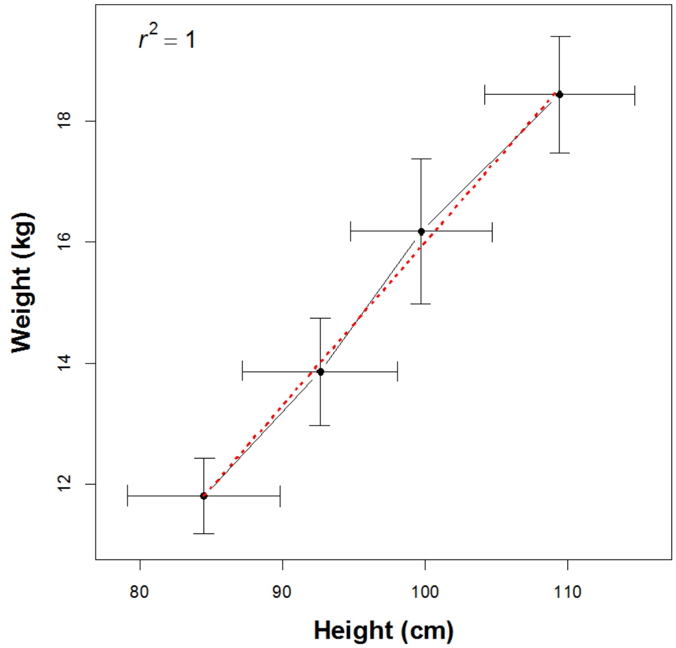
Example 1 Relationship between the mean values of weight and height for each age.



Example 2 As in the example 1 but adding the text labels of the age with the argument *textlabel=TRUE*.



Example 3 As in the example 1 but a linear regression line is added with the argument *reg=TRUE* and also is shown the standard deviation on the variable height with the argument *barX=TRUE*.



In the TXT file that generates the function, the linear regression linear is shown, where the variable height is significant (p < 0.001, see *Pr(>|t|)*) and, therefore, the model as a whole was also significant (p < 0.001, see *p-value* at the end of the results).

The r^2 (see *Multiple R-squared*) shows that hight explains a 99.6% of the observed variance in the weight. The r^2 adjusted (see *Ajusted R-squared*) takes into account the size of the sample to determine the proportion above and, in this case, it shows a lower value 99.4%. The r^2 adjusted should be used to compare models with different numbers of observations or independent variables. The equation of the potential regression model must be expressed in this way: $Weight = -10.97 + 0.2698 * Height$

```
[1] "LINEAR REGRESSION"

[[2]]

Call:
lm(formula = fo, data = datos2)

Residuals:
         1          2          3          4 
-0.0003744 -0.1482920  0.2569195 -0.1082531 

Coefficients:
             Estimate Std. Error t value Pr(>|t|)   
(Intercept) -10.97154    1.17979   -9.30  0.01137 * 
Height        0.26980    0.01217   22.17  0.00203 **
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.2233 on 2 degrees of freedom
Multiple R-squared:  0.9959,    Adjusted R-squared:  0.9939 
F-statistic: 491.7 on 1 and 2 DF,  p-value: 0.002028
```

In the following table, the results of the test of Kolmogorov-Smirnov normality with Lilliefors' correction, the test for autocorrelation of Durbin-Watson statistic and the Breusch-Pagan test of homoscedasticity are shown.

Normality the test of Kolmogorov-Smirnov normality with Lilliefors' correction is not shown because the number of values is lower than 5.

Autocorrelation The requirement that there should be no autocorrelation is met because in the test of Durbin-Watson statistic p = 0.7697. This means that the value of r^2 of the 99.6% is all due to the dependent variable, the height, so it is not in part due to the own dependent variable that is auto explained. If there is autocorrelation, it is not possible to know exactly how much is the variance explained by the independent variable. Anyway it is necessary to mention that the probability value of the test of Durbin-Watson statistic can be less than 0.05 easily when there are many data. The statistical DW, whose value is 3.2 in this example, is a better indicator of the autocorrelation when the number of data is very large. According to Durbin & Watson (1951), a DW less than 1 means a strong positive autocorrelation, a DW greater than 4 a strong negative autocorrelation, values between 1 and 3 a moderate autocorrelation, and a value close to 2 means that there is no autocorrelation.

Homoscedasticity Finally, the requirement of homoscedasticity of the residuals is also satisfied, because the likelihood of the Breusch-Pagan test is p = 0.553. If this requirement is not fulfilled, it means that the model is not as predictive for the entire range of values of the dependent variable.

```
[1] "Normality"

[[4]]
[1] "It was not possible to perform the Lilliefors test for normality test, n must be between 5 and 5000"

[[5]]
[1] "Autocorrelation"

[[6]]

	Durbin-Watson test

data:  reg
DW = 3.2033, p-value = 0.7697
alternative hypothesis: true autocorrelation is greater than 0


[[7]]
[1] "Homocedasticity"

[[8]]

	studentized Breusch-Pagan test

data:  reg
BP = 0.3522, df = 1, p-value = 0.5529
```

Value

A simple line chart with mean error bars, with or without linear regression and with or without text labels is obtained. A CVS file with the mean, median, standard error and standard deviation for each category of the variable *Factor* is also obtained.

References

Durbin, J. & Watson G.S. (1951) Testing for serial correlation in least squares regression. *Biometrika*, **38**, 159-171.

Gross, J. (2013) Tests for Normality. R package version 1.0-2. Available at: https://CRAN.R-project.org/package=nortest.

Hothorn, T. et al., (2013) Testing Linear Regression Models. R package version 0.9-33. Available at: https://CRAN.R-project.org/package=lmtest.

Examples

```
## Not run:

#Example 1

data(Z14)

F33(data=Z14, varY="Weight", varX="Height", Factor="Age", XLAB="Height (cm)",
YLAB="Weight (kg)")

#Example 2

data(Z14)

F33(data=Z14, varY="Weight", varX="Height", Factor="Age", textlabel=TRUE,
XLAB="Height (cm)", YLAB="Weight (kg)")

#Example 3

data(Z14)

F33(data=Z14, varY="Weight", varX="Height", Factor="Age", barX=TRUE,
reg=TRUE, XLAB="Height (cm)", YLAB="Weight (kg)")

## End(Not run)
```

F34 *SIMPLE DOT OR ERROR BAR LINE CHARTS FOR VARIABLE X QUALITATIVE*

Description

It performs a simple dot line chart with mean and error bars for variable X qualitative.

Usage

```
F34(data, varY,  FactorX, method="mean", dev="sd", type="b", ResetPAR=TRUE,
PAR=NULL, order=NULL, OrderCat=NULL, LabelCat=NULL, XLAB=NULL, YLAB=NULL,
XLIM=NULL, YLIM=NULL, COLOR="black",  COLORI="black", PCH=16, ltyL=1,
lwdL=1, CEX=1, LEGEND=NULL, AXIS=NULL, MTEXT= NULL, TEXT=NULL)
```

Arguments

`data`	Data file.
`varY`	Dependent variable.
`FactorX`	Qualitative independent variable.
`method`	If it is not NULL, the average of each category of the independent variable *FactorX* is estimated with the "mean" or the "median".
`dev`	If the argument *method* is not NULL, the error bars may be estimated using the standard deviation ("sd") or the standard error ("se").
`type`	Character string giving the type of plot desired. The following values are possible: "p" for points, "l" for lines, "b" for both points and lines, "c" for empty points joined by lines, "o" for overplotted points and lines, "s" and "S" for stair steps and "h" for histogram-like vertical lines. Finally, "n" does not produce any points or lines.
`ResetPAR`	If it is FALSE, the default condition of the function PAR is not placed and maintained those defined by the user in previous graphics.
`PAR`	It accesses the function PAR that allows to modify many different aspects of the graph.
`order`	If it is NULL the categories are ordered as found in the variable *FactorX*, if it is "increasing" are ordered from lesser to greater median or mean according to the method selected in the argument *method*, if it is "decreasing" are ordered from greater to lesser median or mean, if it is "alhaAZ" are ordered from A to Z and if it is "alphaZA" from Z to A.
`OrderCat`	It allows to specify a vector with the order in which the categories are shown. If this argument is specified, the argument *order* is not taken into account.
`LabelCat`	It allows to specify a vector with the names of the categories.
`XLAB`	Legend of the X axis.
`YLAB`	Legend of the Y axis.
`XLIM`	Vector with the limits of the X axis.
`YLIM`	Vector with the limits of the Y axis.
`COLOR`	Color of the symbols.
`COLORI`	Color of the error bars.
`PCH`	Graphic symbol (see the description of the same argument in the function F1).
`ltyL`	Type of the line chart (see figure of the argument *lty* in the function F1).
`lwdL`	Line width of the chart relative to the default (default=1), so 2 is twice as wide.
`CEX`	Size of the symbols.
`LEGEND`	It allows to include a legend to the graph.
`AXIS`	It allows to add axes to the graph.
`MTEXT`	It allows to add text on the margins of the graph.
`TEXT`	It allows to add text in any area of the inner part of the graph.

Details

FUNCTIONS

The plot is performed with the functions boxplot, points and arrows of base graphics package.

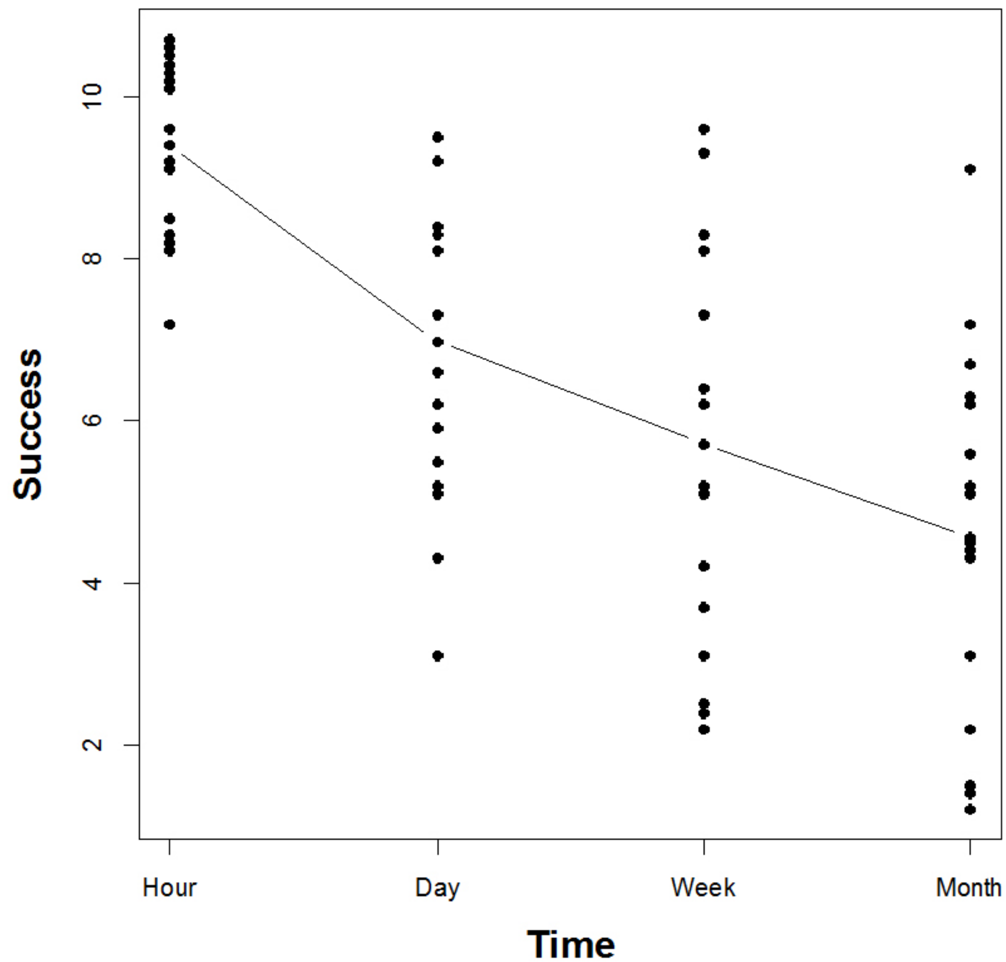
EXAMPLES

In an experiment conducted with expert tasters and people who had no experience tasting, they were taught to identify 15 types of wines from different regions.

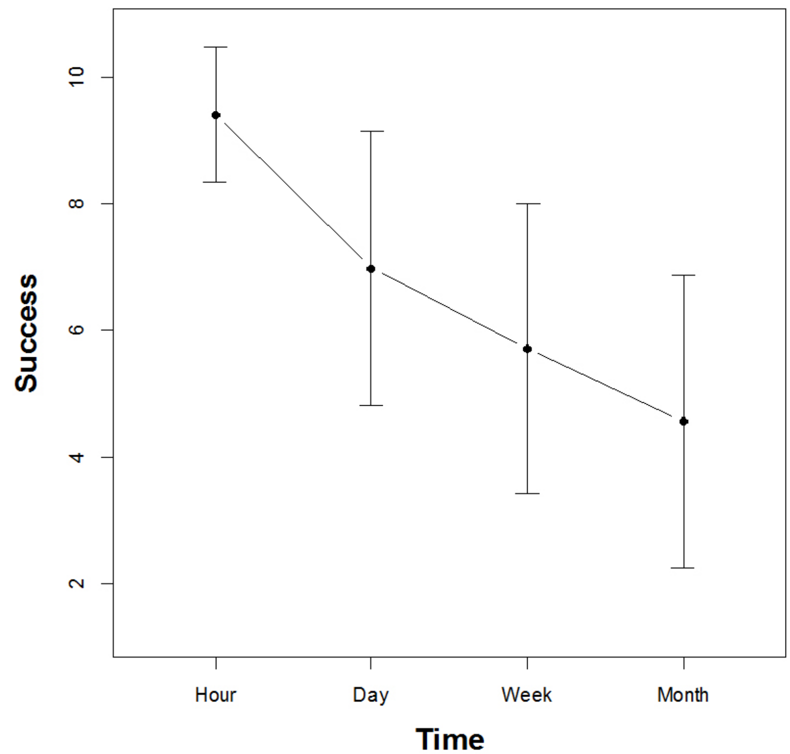
Variations in ability to ascertain the wine provenance over time (after one hour, one day, one week and one month) was measured between experts and non-experts.

For every time, each person assessed a large number of samples and the degree of success was recorded on a scale of 0 to 12.

Example 1 A dot plot is depicted with the argument *method=NULL* of the variable *Success* over time.



Example 2 The mean and the standard deviation of the variable *Success* is obtained for each time.



Value

A dot or mean error bar line charts are obtained.

Examples

```
## Not run:

#Example 1

data(Z15)

F34(data=Z15, varY="Success", FactorX="Time", method=NULL)

#Example 2

F34(data=Z15, varY="Success", FactorX="Time")

## End(Not run)
```

F35 *SIMPLE MEAN WITH ERROR BARS LINE CHART FOR VARIABLE X QUALITATIVE WITH TEXT LABELS*

Description

It performs a simple mean with error bars line chart for variable X qualitative with text labels.

Usage

```
F35(data, varY,  FactorX, label=NULL, method="mean", dev="sd", type="b",
ResetPAR=TRUE, PAR=NULL, order=NULL, OrderCat=NULL, LabelCat=NULL,
XLAB=NULL, YLAB=NULL, XLIM=NULL, YLIM=NULL, COLOR="black", COLORI="black",
PCH=16, ltyL=1, lwdL=1, CEX=1, LEGEND=NULL, AXIS=NULL, MTEXT= NULL, TEXT=NULL)
```

Arguments

`data`	Data file.
`varY`	Dependent variable.
`FactorX`	Qualitative independent variable.
`label`	It allows to specify the characteristics of the text labels with the function text.
`method`	The average of each category of the independent variable *FactorX* is estimated with the "mean" or the "median".
`dev`	The error bars may be estimated using the standard deviation ("sd") or the standard error ("se").
`type`	Character string giving the type of plot desired. The following values are possible: "p" for points, "l" for lines, "b" for both points and lines, "c" for empty points joined by lines, "o" for overplotted points and lines, "s" and "S" for stair steps and "h" for histogram-like vertical lines. Finally, "n" does not produce any points or lines.
`ResetPAR`	If it is FALSE, the default condition of the function PAR is not placed and maintained those defined by the user in previous graphics.
`PAR`	It accesses the function PAR that allows to modify many different aspects of the graph.
`order`	If it is NULL the categories are ordered as found in the variable *FactorX*, if it is "increasing" are ordered from lesser to greater median or mean according to the method selected in the argument *method*, if it is "decreasing" are ordered from greater to lesser median or mean, if it is "alhaAZ" are ordered from A to Z and if it is "alphaZA" from Z to A.
`OrderCat`	It allows to specify a vector with the order in which the categories are shown. If this argument is specified, the argument *order* is not taken into account.
`LabelCat`	It allows to specify a vector with the names of the categories.
`XLAB`	Legend of the X axis.
`YLAB`	Legend of the Y axis.
`XLIM`	Vector with the limits of the X axis.
`YLIM`	Vector with the limits of the Y axis.
`COLOR`	Color of the symbols.
`COLORI`	Color of the error bars.

`PCH`	Graphic symbol (see the description of the same argument in the function F1).
`ltyL`	Type of the line chart (see figure of the argument *lty* in the function F1).
`lwdL`	Line width of the chart relative to the default (default=1), so 2 is twice as wide.
`CEX`	Size of the symbols.
`LEGEND`	It allows to include a legend to the graph.
`AXIS`	It allows to add axes to the graph.
`MTEXT`	It allows to add text on the margins of the graph.
`TEXT`	It allows to add text in any area of the inner part of the graph.

Details

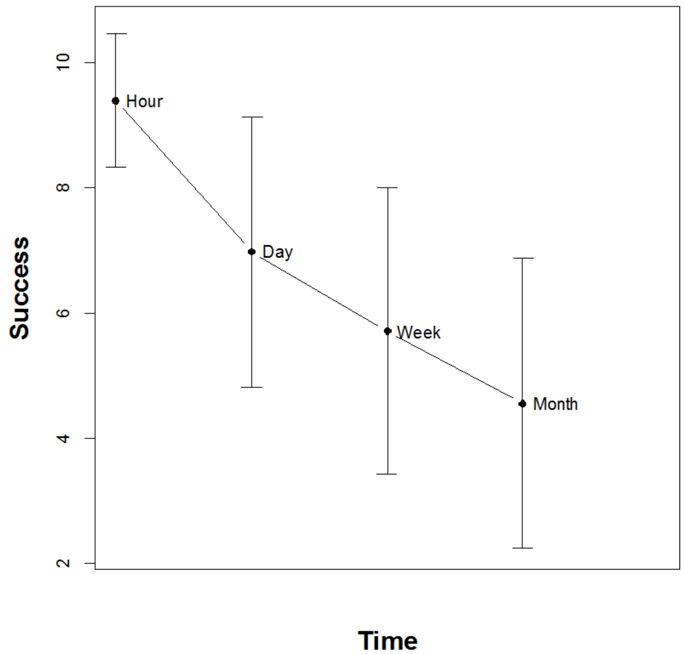
FUNCTIONS

The plot is performed with the functions boxplot, points and arrows, and the text labels with the funcion text, all of them of base graphics package.

EXAMPLES

In an experiment conducted with expert tasters and people who had no experience tasting, they were taught to identify 15 types of wines from different regions. Variations in ability to ascertain the wine provenance over time (after one hour, one day, one week and one month) was measured between experts and non-experts. For every time, each person assessed a large number of samples and the degree of success was recorded on a scale of 0 to 12.

The mean and the standard deviation of the variable *Success* is obtained for each time, showing each time with text labels.



Value

A mean with error bars line chart with text labels is obtained.

Examples

```
## Not run:

data(Z15)

F35(data=Z15, varY="Success", Factor="Time")

## End(Not run)
```

F36 *MULTIPLE LINE CHARTS FOR VARIABLE X QUANTITATIVE*

Description

It performs a multiple line chart with or without text labels and a regression model for each category.

Usage

```
F36(data, varY,  varX, group, textlabel=NULL, type="b", label=NULL,
reg=FALSE, model="Linear", outliers=FALSE, quant1=0.05, quant2 = 0.95,
ResetPAR=TRUE, PAR=NULL, XLAB=NULL, YLAB=NULL, COLOR=NULL, COLORR=NULL,
PCH=NULL, CEX=1, lty=NULL, lwd=2.5, ltyL=NULL, lwdL=1, PLOT=NULL, LEGEND=NULL,
AXIS=NULL, MTEXT=NULL, TEXT=NULL, dec=",", file="Output.txt")
```

Arguments

`data`	Data file.
`varY`	Dependent variable.
`varX`	Quantitative independent variable.
`group`	Variable with the categories to be grouped.
`textlabel`	Variable with the text labels.
`type`	Character string giving the type of plot desired. The following values are possible: "p" for points, "l" for lines, "b" for both points and lines, "c" for empty points joined by lines, "o" for overplotted points and lines, "s" and "S" for stair steps and "h" for histogram-like vertical lines. Finally, "n" does not produce any points or lines.
`label`	It allows to specify the characteristics of the text labels with the function text.
`reg`	If TRUE a regression model is performed.
`model`	One regression model can be selected: "Linear" , "Log", "S-curve", "Power", "Exp", "Quadratic", "Cubic", "Inverse". It is not considered the model in those cases in which there is the logarithm that apply to any of the variables, if any value of the variable, which applies the logarithm, is zero or negative. The inverse model is not calculated if any value of the independent variable is zero.
`outliers`	If it is TRUE, the outliers are removed using the selected regression model.
`quant1`	Quantile of the lower end to the elimination of outliers.
`quant2`	Quantile of the upper end to the elimination of outliers.
`ResetPAR`	If it is FALSE, the default condition of the function PAR is not placed and maintained those defined by the user in previous graphics.
`PAR`	It accesses the function PAR that allows to modify many different aspects of the graph.
`XLAB`	Legend of the X axis.
`YLAB`	Legend of the Y axis.
`COLOR`	Color of the symbols. It must be as many as different categories of the variable *group*.
`COLORR`	Color of the line of the regression model. It must be as many as different categories of the variable *group*.
`PCH`	Graphic symbol (see the description of the same argument in the function F1). It must be as many as different categories of the variable *group*.
`CEX`	Size of the symbols.

`lty`	Type of the regression line (see the description of the same argument in the function F1).
`lwd`	Line width of the regression line.
`ltyL`	Type of the line chart (see figure of the argument *lty* in the function F1).
`lwdL`	Line width of the line chart.
`PLOT`	It allows to specify the characteristics of the function plot.default.
`LEGEND`	It allows to modify the legend of the graph.
`AXIS`	It allows to add axes to the graph.
`MTEXT`	It allows to add text on the margins of the graph.
`TEXT`	It allows to add text in any area of the inner part of the graph.
`dec`	It defines if the comma "," is used as decimal separator or the dot ".".
`file`	TXT FILE. If the argument *reg=TRUE* a TXT file is saved with the information of the regression.

Details

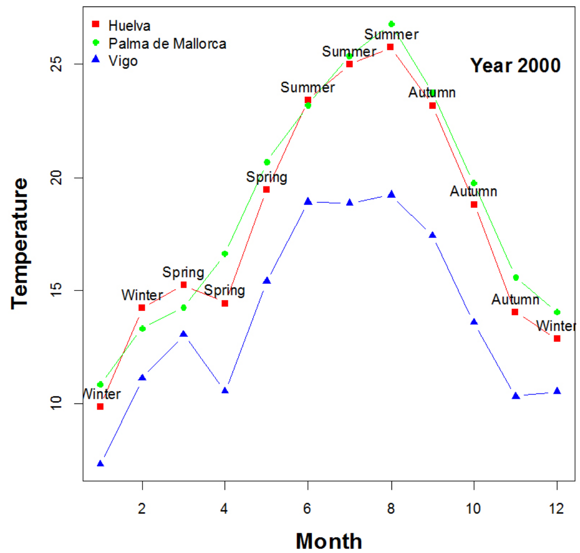
FUNCTIONS

The plot is performed with the function plot.default of base graphics package and the linear regression with the function lm of base stats package. The function lillie.test of the package nortest (Gross, 2013) is used to perform the test of Normality Kolmogorov-Smirnov with Lilliefors'correction, the function dwtest of the package lmtest (Hothorn et al., 2013) to analyze the autocorrelation with the test and the Durbin-Watson statistic function bptest of the package lmtest (Hothorn et al., 2013) to perform the Breusch-Pagan test of homoscedasticity.

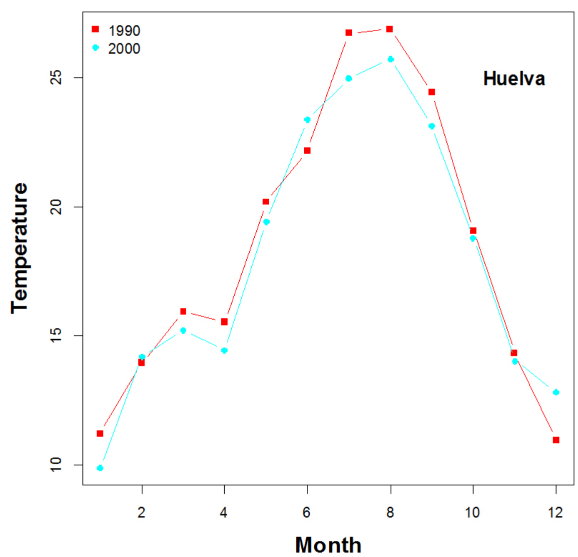
EXAMPLES

The data are monthly mean temperature for 1990 and 2000 in three cities in Spain: Huelva, Palma de Mallorca and Vigo. They were obtained from the Agencia Estatal de Meteorología of Spain `https://www.aemet.es/es/portada`.

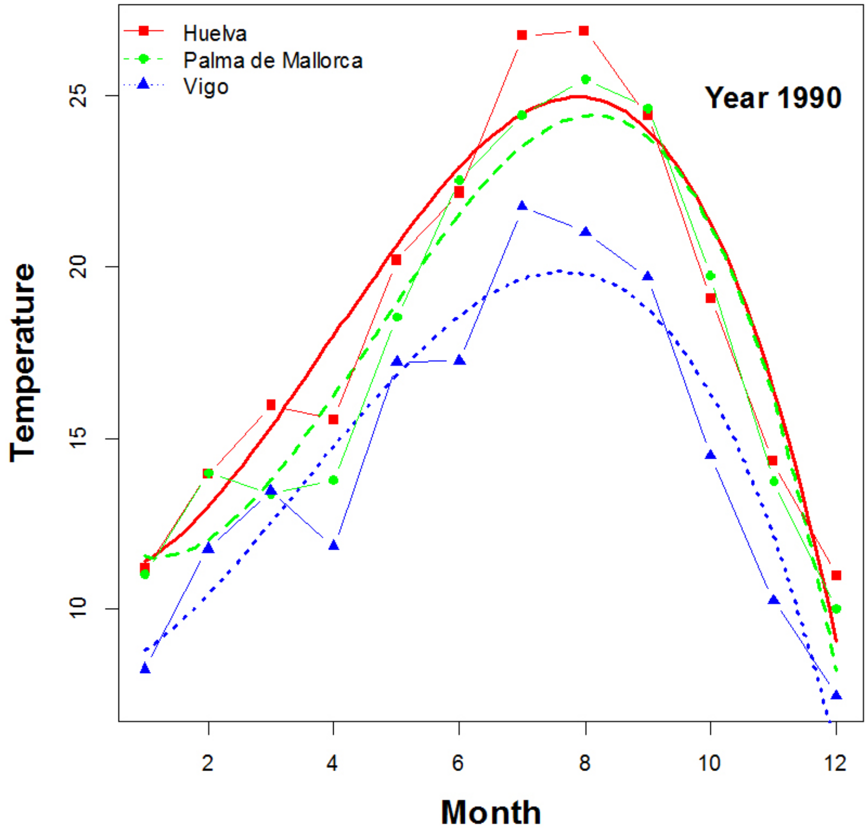
Example 1 Monthly temperature in the three cities in the year 2000. Text labels are assigned to the points with the argument *textlabel="SeasonA"*.



Example 2 Monthly temperature in Huelva for the years 1990 and 2000 without text labels.



Example 3 A cubic regression line is added with the argument *reg=TRUE* and *Cubic*.



In the TXT file that generates the function, the regression model for each city is shown. For the explanation of the regression models, normality, autocorrelation and homoscedasticity see the *details* section of the function F1.

Value

A multiple line chart with or without text labels and regression models for different categories is obtained.

References

Durbin, J. & Watson G.S. (1951) Testing for serial correlation in least squares regression. *Biometrika*, **38**, 159-171.

Gross, J. (2013) Tests for Normality. R package version 1.0-2. Available at: `https://CRAN.R-project.org/package=nortest`.

Hothorn, T. et al., (2013) Testing Linear Regression Models. R package version 0.9-33. Available at: `https://CRAN.R-project.org/package=lmtest`.

Examples

```
## Not run:
```

```
#Example 1

data(Z13)

data<-subset(Z13,(Year == 2000))

F36(data=data, varY="Temperature", varX="Month", group="City", textlabel="SeasonA",
TEXT = c("x = 11" , "y=25", "labels = 'Year 2000'", "font=2", "cex=1.3"))

#Example 2

data(Z13)

data<-subset(Z13,(City == "Huelva"))

F36(data=data, varY="Temperature", varX="Month", group="Year", TEXT = c("x=11",
"y=25", "labels='Huelva'", "font=2", "cex=1.3"))

#Example 3

data(Z13)

data<-subset(Z13,(Year == 1990))

F36(data=data, varY="Temperature", varX="Month", group="City", reg=TRUE,
model="Cubic", TEXT = c("x=11" , "y=25", "labels='Year 1990'", "font=2", "cex=1.3"))

## End(Not run)
```

F37 *OPTIMAL ENVIRONMENTAL DIAGRAMS*

Description

This function allows to show in a plot the environmental conditions were there are a higher number of records of one or several species, so it is possible to determine the niche conditions of one or several species and, to create boxplots with the range of environmental variables and list of species in an area of the niche selected by the user.

Usage

```
F37(data, variables, Level="NULL", Taxon="NULL", cor=TRUE, ResetPAR=TRUE, PAR=NULL,
d.main=0.5, xlab="Polar coordinate X in pixels", ylab="Polar coordinate Y in pixels",
cex.labS=1.5, font.lab=1, main="", colramp = IDPcolorRamp, cex.main = 2,
font.main=2, nlab.xaxis = 5, nlab.yaxis = 5, minL.axis = 3, las = 1,
border = FALSE, tcl = -0.3, boxplot=TRUE, outline=FALSE, color="NULL",
range = 1.5, width = NULL, varwidth = FALSE, plot = TRUE,
pars = list(boxwex = 0.8, staplewex = 0.5, outwex = 0.5), cex.boxplot=1.5,
```

```
cex.labB=1.5, namesB, family="serif", line=1, file1="List of species.csv",
file2="Environmental variables.csv", na="NA", dec=",", row.names=FALSE,
fileEncoding = "")
```

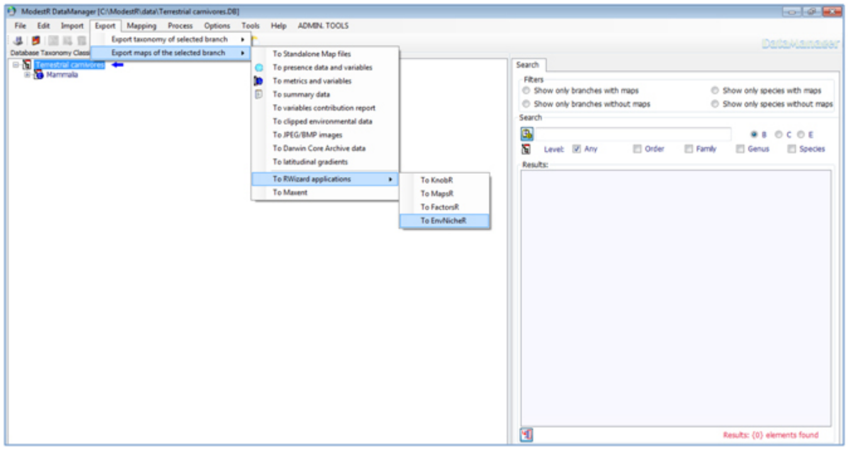
Arguments

`data`	A CSV file obtained from ModestR (García-Roselló et al., 2013) with data which show the presence of the species and abiotic and/or biotic factors.
`variables`	Selection of the variables for the estimation of the niche.
`Level`	Taxonomic level to be selected, i.e., class, order, family, genus or species.
`Taxon`	Name of the taxon or taxa selected within the level, i.e., name of the Order, Family, etc. Can be a vector, so several taxa.
`cor`	If TRUE the variables are ordered according to the correlation between them when estimating the polar coordinates. Therefore, the next variable to another variable is the one that has a greater positive correlation.
`ResetPAR`	If it is FALSE, the default condition of the function PAR is not placed and maintained those defined by the user in previous graphics.
`PAR`	It accesses the function PAR that allows to modify many different aspects of the graph.
`d.main`	Scatter plot. Vertical distance between upper border of scatter plots and the title line in multiples of title height.
`xlab`	Scatter plot. Label for x-axis.
`ylab`	Scatter plot. Label for y-axis.
`cex.labS`	Scatter plot. Magnification used for text in axis labels relative to the current setting of cex.
`font.lab`	Scatter plot. The font to be used for x and y labels.
`main`	Scatter plot. Title of the plot.
`colramp`	Scatter plot. Color ramp to encode the number of counts within a pixel.
`cex.main`	Scatter plot. Magnification used for title relative to the current setting of cex.
`font.main`	Scatter plot. The font to be used for plot main titles.
`nlab.xaxis`	Scatter plot. Approximate number of labels on x-axes.
`nlab.yaxis`	Scatter plot. Approximate number of labels on y-axes.
`minL.axis`	Scatter plot. The minimum length of the abbreviations of factor levels, used to label the axes ticks.
`las`	Scatter plot. Orientation of labels on axes.
`border`	Scatter plot. Logical. When TRUE, a border is drawn around the individual colors in the legend.
`tcl`	Scatter plot. The length of tick marks as a fraction of the height of a line of text. The default value is -0.5; setting tcl = NA sets tck = -0.01 which is S' default.
`boxplot`	If TRUE (the default) then a boxplot with the range of environmental variables in an area of the niche selected by the user is produced.

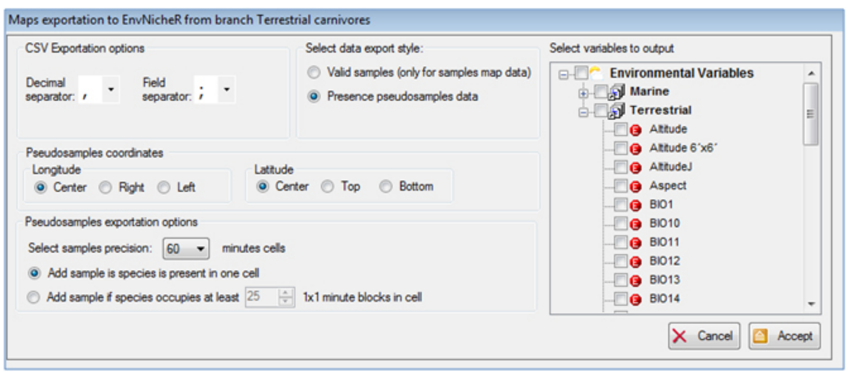
outline	Boxplot. If outline is not true, the outliers are not drawn (as points whereas S+ uses lines).
color	Boxplot. If col is non-null it is assumed to contain colors to be used to colour the bodies of the box plots.
range	Boxplot. This determines how far the plot whiskers extend out from the box. If the range is positive, the whiskers extend to the most extreme data point which is no more than range times the interquartile range from the box. A value of zero causes the whiskers to extend to the data extremes.
width	Boxplot. A vector giving the relative widths of the boxes making up the plot.
varwidth	Boxplot. If varwidth is TRUE, the boxes are drawn with widths proportional to the square-roots of the number of observations in the groups.
plot	Boxplot. If TRUE (the default) then a boxplot is produced. If not, the summaries which the boxplots are based on are returned.
pars	Boxplot. A list of (potentially many) more graphical parameters, e.g., boxwex or outpch; these are passed to bxp (if plot is true).
cex.boxplot	Boxplot. Magnification used for axis annotation.
cex.labB	Boxplot. Magnification used for group labels which will be printed under each boxplot.
namesB	Boxplot. Group labels which will be printed under each boxplot. It can be a character vector.
family	The name of a font family for drawing text.
line	mtext. On which margin line, starting at 0 counting outwards.
file1	CSV file. A character string naming the file of the list of species.
file2	CSV file. A character string naming the file with the summary of the environmental variables.
na	CSV files. The string to use for missing values in the data.
dec	CSV files. The string to use for decimal points in numeric or complex columns: must be a single character.
row.names	CSV files. Either a logical value indicating whether the row names of x are to be written along with x, or a character vector of row names to be written.
fileEncoding	CSV files. Character string: if non-empty declares the encoding to be used on a file (not a connection) so the character data can be re-encoded as they are written.

Details

The file required in the argument *data* may be obtained using ModestR (available at the web site www.ipez.es/ModestR), as it is shown in the following screenshot (Export/Export maps of the select branch/To RWizard Applications/To EnvNicheR). It is better do not include duplicates, i.e., records with the same longitude and latitude.



The menu shown in the following screenshot is obtained, where it is possible to select several environmental variables. There is the option of exporting the data with the format of pseudosamples or all the valid samples. If the maps are areas, the proper way of exporting these data is to create a raster with grid cell for instance of 5´ x 5´, 30´ x 30´, 1° x 1°, etc. Therefore, the output of ModestR is a list of species within each of the grid cells with the size defined by the user. If the maps are records, it is possible to use pseudosamples or to select the option valid samples.



The format of the CSV file obtained is shown in the following screenshot, and this CSV file is the one required in this argument *data*. The first only five columns must be taxonomic levels as class, order, family, subfamily, tribe, genus, subgenus, species, etc. The columns 6 and 7 must be longitude and latitude of the record, respectively. The rest of columns are the abiotic/biotic factors.

Class	Order	Family	Genus	Species	Longitude	Latitude	Altitude	BIO1	BIO12
Mammalia	Carnivora	Canidae	Canis	Canis lupus	-171,5	63,5	33	-3,9	431
Mammalia	Carnivora	Canidae	Canis	Canis lupus	-170,5	63,5	273	-5	427
Mammalia	Carnivora	Canidae	Canis	Canis lupus	-169,5	63,5			
Mammalia	Carnivora	Canidae	Canis	Canis lupus	-169,5	62,5			
Mammalia	Carnivora	Canidae	Canis	Canis lupus	-168,5	65,5			
Mammalia	Carnivora	Canidae	Canis	Canis lupus	-168,5	63,5			
Mammalia	Carnivora	Canidae	Canis	Canis lupus	-167,5	65,5	338	-6,8	424
Mammalia	Carnivora	Canidae	Canis	Canis lupus	-166,5	68,5			
Mammalia	Carnivora	Canidae	Canis	Canis lupus	-166,5	66,5			
Mammalia	Carnivora	Canidae	Canis	Canis lupus	-166,5	65,5	311	-6,2	398

All variables are transformed to a scale ranged between -1 and 1. For each record the X and Y polar coordinates are estimated using the following equations:

$$X = \sum_{i=1}^{n} |z_j| cos(\alpha) \quad Y = \sum_{i=1}^{n} |z_j| sin(\alpha)$$

where *z* is the record of the variable *j* and *n* the number of variables.

Each variable is assigned an angle (α). The increment value of the angle is always $\frac{360}{n*2}$. If for instance the number of variables are 5, the increment angle is 36. Therefore, for the first variable if the value is ≥ 0 the α is 36 and if the value is < 0 the α is 36+180, for the second variable if the value is ≥ 0 the α is 36+36 and if the value is < 0 the α is 36+36+180, etc. Degrees to radians angle conversion is carried out assuming that 1 degree = 0.0174532925 radians.

Therefore, the order of the variables is important because a different α is assigned. If the argument *cor=TRUE*, the order is established calculating the correlation matrix of the variables, and ordering them in the way that each variable will be followed by the variable to which is highly correlated. The goal is to favor a larger dispersion of the data in the resulting polar coordinates system.

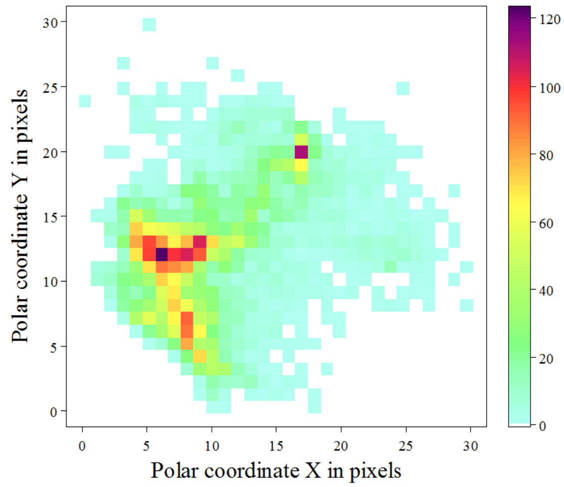
FUNCTIONS

The scatter plot is performed with the function iplot of the package IDPmisc (Locher & Ruckstuhl, 2014).

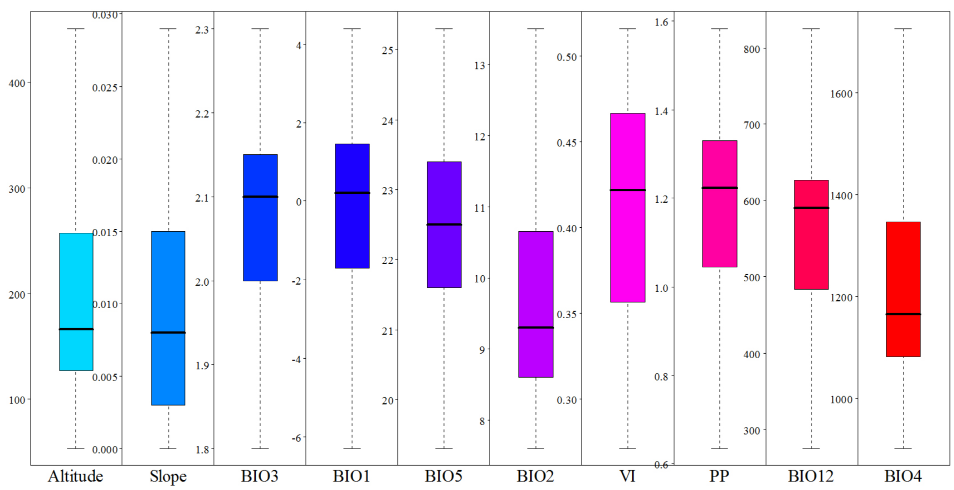
EXAMPLE

The dataset is a matrix of the presence of the wolf and the mean altitude, mean annual temperature (BIO1), mean diurnal range (BIO2), isothermality (BIO3), temperature seasonality (BIO4), maximum temperature of the warmest month (BIO5), mean annual precipitation (BIO12), primary terrestrial production (PP), slope and vegetation index (VI) in cells of 1 degree x 1 degree around the world.

The first plot shows the polar coordinates using the environmental variables selected by the user in the file obtained from ModestR (in the example altitude, BIO1, BIO12, BIO2, BIO3, BIO4, BIO5, PP, slope and VI). In this first plot, a darker color of the square indicates a higher number of records of the wolf in the cell. In this plot it is necessary to click four times with the mouse to select one or several pixels.



The second plot shows a boxplot with the median and range of the environmental variables in the pixels selected with the mouse in the first plot.



Value

A list of the species present in the cells selected by the user with the mouse and a summary of the environmental variables are saved in two CSV files.

References

García-Roselló, E., Guisande, C., González-Dacosta, J., Heine, J., Pelayo-Villamil, P., Manjarrés-Hernández, A., Vaamonde, A. & Granado-Lorencio, C. (2013) ModestR: a software tool for managing and analyzing species distribution map databases. *Ecography*, 36, 1202-1207.

Hijmans, R.J., Cameron, S.E., Parra, J.L., Jones, P.G. and Jarvis, A. (2005)Very high resolution interpolated climate surfaces for global land areas. *International Journal of Climatology*, 25, 1965-1978.

IUCN (2012) The IUCN Red List of Threatened Species. Version 2012.2. https://www.iucnredlist.org/. Downloaded on 17 October 2012.

Locher, R. & Ruckstuhl, A. (2014) Utilities of Institute of Data Analyses and Process Design. R package version 1.1.17. Available at: https://CRAN.R-project.org/package=IDPmisc.

Examples

```
## Not run:
data(Z16)

F37(data=Z16 , variables=c("Altitude", "BIO1", "BIO12", "BIO2",
"BIO3","BIO4","BIO5","PP","Slope","VI"))

## End(Not run)
```

F38 *MULTIPLE MEAN WITH ERROR BARS LINE CHART FOR VARIABLE X QUANTITATIVE WITH TEXT LABELS AND REGRESSION*

Description

It performs a multiple mean with error bars line chart for variable X quantitative with text labels and a regression model.

Usage

```
F38(data, varY, varX, Factor, group, type="b", method="mean", dev="sd", barY=TRUE,
barX=FALSE, textlabel=FALSE, label=NULL, reg=FALSE, model="Linear",
outliers=FALSE, quant1=0.05, quant2 = 0.95, ResetPAR=TRUE, PAR=NULL, XLAB=NULL,
YLAB=NULL, XLIM=NULL, YLIM=NULL,  COLOR=NULL, COLORI="black", COLORR=NULL, PCH=NULL,
CEX=1, lty=NULL, lwd=2.5, ltyL=NULL, lwdL=1, PLOT=NULL, LEGEND=NULL, AXIS=NULL,
MTEXT= NULL, TEXT=NULL, file1="Output.txt", file2="Average and error bars.csv",
na="NA", dec=",", row.names=FALSE)
```

Arguments

data	Data file.
varY	Dependent variable.
varX	Quantitative independent variable.
Factor	Variable for the estimation of the average and error bars for each category of the variable. It is not possible to include variables with any of the categories with a single data, so if necessary several data for each category.
group	Variable with the categories to be grouped.

`type`	Character string giving the type of plot desired. The following values are possible: "p" for points, "l" for lines, "b" for both points and lines, "c" for empty points joined by lines, "o" for overplotted points and lines, "s" and "S" for stair steps and "h" for histogram-like vertical lines. Finally, "n" does not produce any points or lines.
`method`	The average of each category of the grouped variable *Factor* is estimated with the "mean" or the "median".
`dev`	The error bars may be estimated using the standard deviation ("sd") or the standard error ("se").
`barY`	If it is TRUE the bar error of the variable Y is depicted.
`barX`	If it is TRUE the bar error of the variable X is depicted.
`textlabel`	If TRUE the text labels of the categories of the variable *Factor* are added to the plot.
`label`	It allows to specify the characteristics of the text labels with the function text.
`reg`	If it is TRUE a regression model is performed for each set of data defined with the argument *group*.
`model`	One regression model can be selected: "Linear" , "Log", "S-curve", "Power", "Exp", "Quadratic", "Cubic", "Inverse". It is not considered the model in those cases in which there is the logarithm that apply to any of the variables, if any value of the variable, which applies the logarithm, is zero or negative. The inverse model is not calculated if any value of the independent variable is zero.
`outliers`	If it is TRUE, the outliers are removed using the selected regression model.
`quant1`	Quantile of the lower end to the elimination of outliers.
`quant2`	Quantile of the upper end to the elimination of outliers.
`ResetPAR`	If it is FALSE, the default condition of the function PAR is not placed and maintained those defined by the user in previous graphics.
`PAR`	It accesses the function PAR that allows to modify many different aspects of the graph.
`XLAB`	Legend of the X axis.
`YLAB`	Legend of the Y axis.
`XLIM`	Vector with the limits of the X axis.
`YLIM`	Vector with the limits of the Y axis.
`COLOR`	Color of the symbols. It must be as many as different categories of the variable *group*.
`COLORI`	Color of the error bars.
`COLORR`	Color of the line of the regression model. It must be as many as different categories of the variable *group*.
`PCH`	Graphic symbol (see the description of the same argument in the function F1). It must be as many as different categories of the variable *group*.
`CEX`	Size of the symbols.
`lty`	Type of the regression line (see the description of the same argument in the function F1).

`lwd`	Line width of the regression line relative to the default (default=1), so 2 is twice as wide.
`ltyL`	Type of the line chart (see figure of the argument *lty* in the function F1).
`lwdL`	Line width of the line chart.
`PLOT`	It allows to specify the characteristics of the function plot.default.
`LEGEND`	It allows to modify the legend of the graph.
`AXIS`	It allows to add axes to the graph.
`MTEXT`	It allows to add text on the margins of the graph.
`TEXT`	It allows to add text in any area of the inner part of the graph.
`file1`	TXT FILE. If the argument *reg=TRUE* a TXT file is saved with the information of the regression.
`file2`	CSV FILE. File name with the mean, median, standard error and standard deviation for each category of the variable *Factor*
`na`	CSV FILES. Text that is used in the cells without data.
`dec`	CSV FILES. It defines if the comma "," is used as decimal separator or the dot ".".
`row.names`	CSV FILES. Logical value that defines if identifiers are put in rows or a vector with a text for each of the rows.

Details

See the equations of all regression models in the section *details* of the function XI1 of the package StatR.

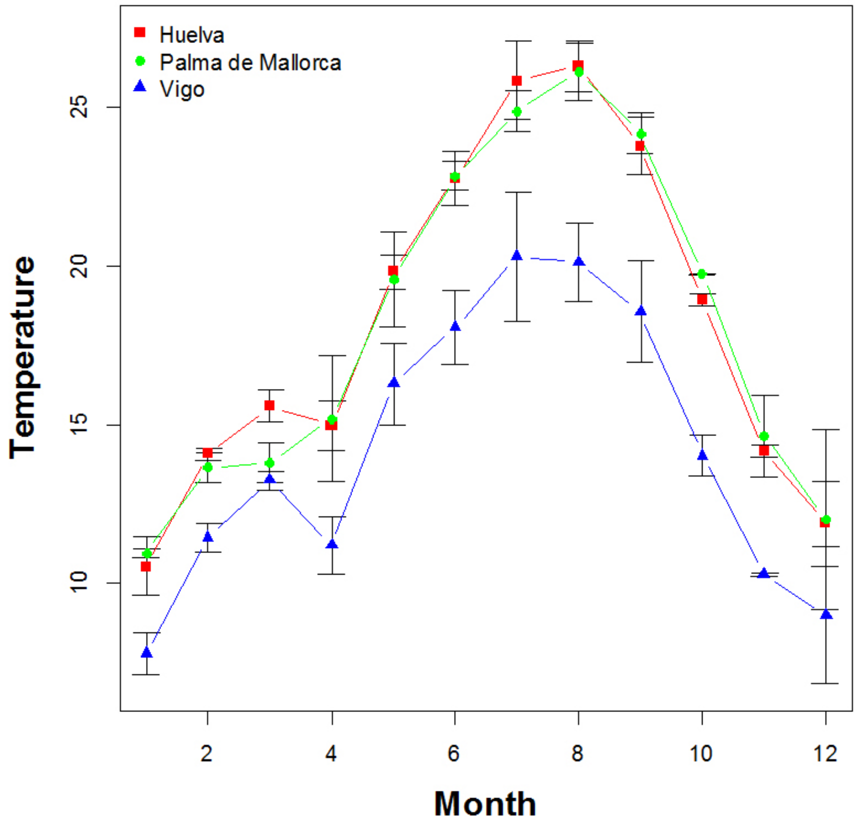
FUNCTIONS

The plot is performed with the function plot.default of base graphics package and the linear regression with the function lm of base stats package. The function lillie.test of the package nortest (Gross, 2013) is used to perform the test of Normality Kolmogorov-Smirnov with Lilliefors'correction, the function dwtest of the package lmtest (Hothorn et al., 2013) to analyze the autocorrelation with the test and the Durbin-Watson statistic function bptest of the package lmtest (Hothorn et al., 2013) to perform the Breusch-Pagan test of homoscedasticity.

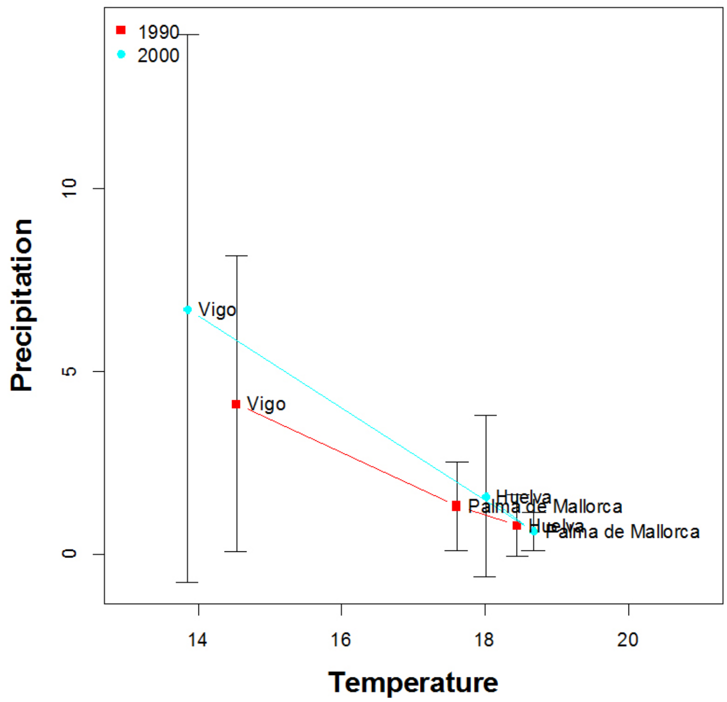
EXAMPLES

The data are monthly mean temperature for 1990 and 2000 in three cities in Spain: Huelva, Palma de Mallorca and Vigo. They were obtained from the Agencia Estatal de Meteorología of Spain `https://www.aemet.es/es/portada`.

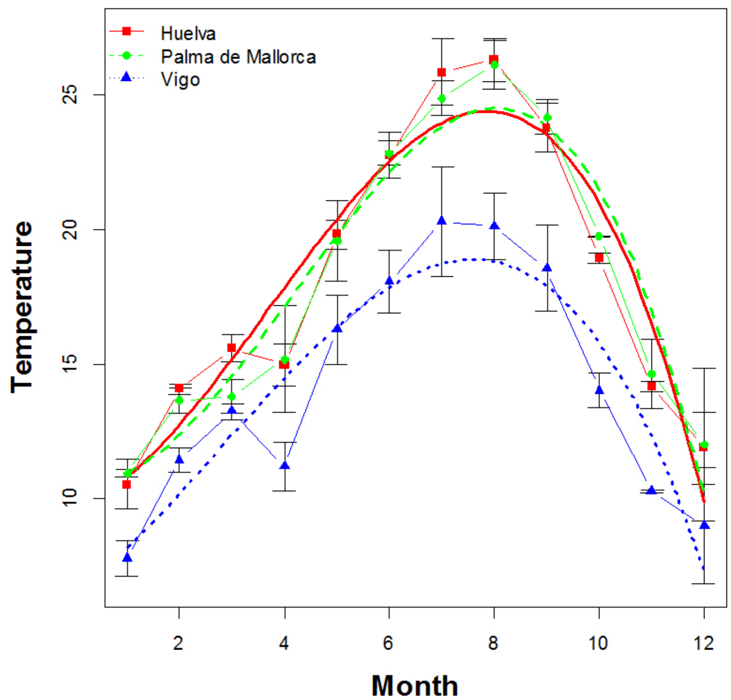
Example 1 Monthly mean temperature in each city.



Example 2 Relationship between mean temperature and mean precipitation for each city in the years 1990 and 2000.



Example 3 Monthly mean temperature in each city and a cubic regression line is added with the argument *reg=TRUE* and *Cubic*.



In the TXT file that generates the function, the regression model for each city is shown. For the explanation of the regression models, normality, autocorrelation and homoscedasticity see the *details* section of the function F1.

Value

A multiple line chart with mean error bars, with or without linear regression and with or without text labels is obtained. A CVS file with the mean, median, standard error and standard deviation for each category of the variable *Factor* is also obtained.

References

Durbin, J. & Watson G.S. (1951) Testing for serial correlation in least squares regression. *Biometrika*, **38**, 159-171.

Gross, J. (2013) Tests for Normality. R package version 1.0-2. Available at: `https://CRAN.R-project.org/package=nortest`.

Guisande, C., Manjarrés-Hernández, A., Pelayo-Villamil, P., Granado-Lorencio, C., Riveiro, I., Acuña, A., Prieto-Piraquive, E., Janeiro, E., Matías, J.M., Patti, C., Patti, B., Mazzola, S., Jiménez, S., Duque, V. & Salmerón, F. (2010) IPez: An expert system for the taxonomic identification of fishes based on machine learning techniques. *Fisheries Research*, 102, 240-247.

Hothorn, T. et al., (2013) Testing Linear Regression Models R package version 0.9-33. Available at: `https://CRAN.R-project.org/package=lmtest`.

Examples

```
## Not run:

#Example 1

data(Z13)

F38(data=Z13, varY="Temperature", varX="Month", Factor="Month", group="City")

#Example 2

data(Z13)

F38(data=Z13, varY="Precipitation", varX="Temperature", Factor="City", group="Year",
textlabel=TRUE, XLIM=c(13,21))

#Example 3

data(Z13)

F38(data=Z13, varY="Temperature", varX="Month", Factor="Month", group="City",
reg=TRUE, model="Cubic")


## End(Not run)
```

F39 *MULTIPLE DOT OR MEAN WITH ERROR BARS LINE CHARTS FOR VARIABLE X QUALITATIVE*

Description

It performs a multiple dot or mean with error bars line charts for variable X qualitative.

Usage

```
F39(data, varY, FactorX, group, type="b", method="mean", dev="sd",
ResetPAR=TRUE, PAR=NULL, order=NULL, OrderCat=NULL, LabelCat=NULL,
XLAB=NULL, YLAB=NULL, XLIM=NULL, YLIM=NULL, COLOR=NULL, COLORI="black",
ltyL=NULL, lwdL=1,PCH=NULL, CEX=1, LEGEND=NULL, AXIS=NULL,MTEXT= NULL, TEXT=NULL)
```

Arguments

`data`	Data file.
`varY`	Dependent variable.
`FactorX`	Qualitative independent variable.
`group`	Variable with the categories to be grouped.

`type` Character string giving the type of plot desired. The possible values are shown in the same argument of function F38.

`method` If it is not NULL, the average of each category of the independent variable *FactorX* is estimated with the "mean" or the "median".

`dev` If the argument *method* is not NULL, the error bars may be estimated using the standard deviation ("sd") or the standard error ("se").

`ResetPAR` If it is FALSE, the default condition of the function PAR is not placed and maintained those defined by the user in previous graphics.

`PAR` It accesses the function PAR that allows to modify many different aspects of the graph.

`order` If it is NULL the categories are ordered as found in the variable *FactorX*, if it is "increasing" are ordered from lesser to greater median or mean according to the method selected in the argument *method*, if it is "decreasing" are ordered from greater to lesser median or mean, if it is "alhaAZ" are ordered from A to Z and if it is "alphaZA" from Z to A.

`OrderCat` It allows to specify a vector with the order in which the categories are shown. If this argument is specified, the argument *order* is not taken into account.

`LabelCat` It allows to specify a vector with the names of the categories.

`XLAB` Legend of the X axis.

`YLAB` Legend of the Y axis.

`XLIM` Vector with the limits of the X axis.

`YLIM` Vector with the limits of the Y axis.

`COLOR` Color of the symbols. It must be as many as different categories of the variable *group*.

`COLORI` Color of the error bars.

`ltyL` Type of the line chart (see figure of the argument *lty* in the function F1).

`lwdL` Line width of the line chart.

`PCH` Graphic symbol (see the description of the same argument in the function F1). It must be as many as different categories of the variable *group*.

`CEX` Size of the symbols.

`LEGEND` It allows to modify the legend of the graph.

`AXIS` It allows to add axes to the graph.

`MTEXT` It allows to add text on the margins of the graph.

`TEXT` It allows to add text in any area of the inner part of the graph.

Details

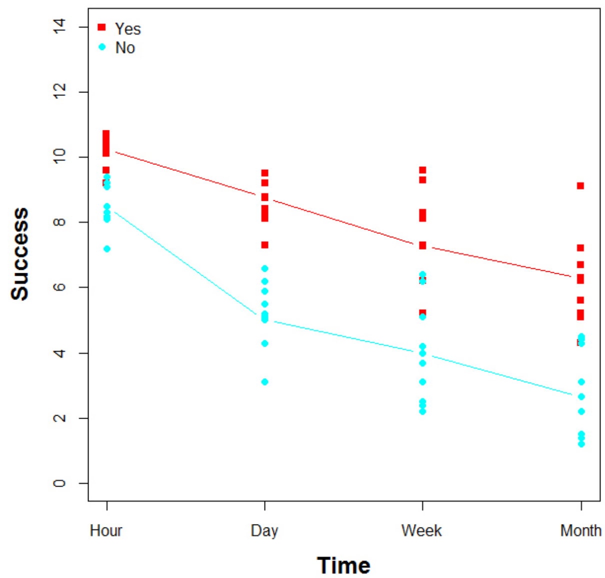
FUNCTIONS

The plot is performed with the functions boxplot, points and arrows of base graphics package. For further details see Guisande & Vammonde (2012).

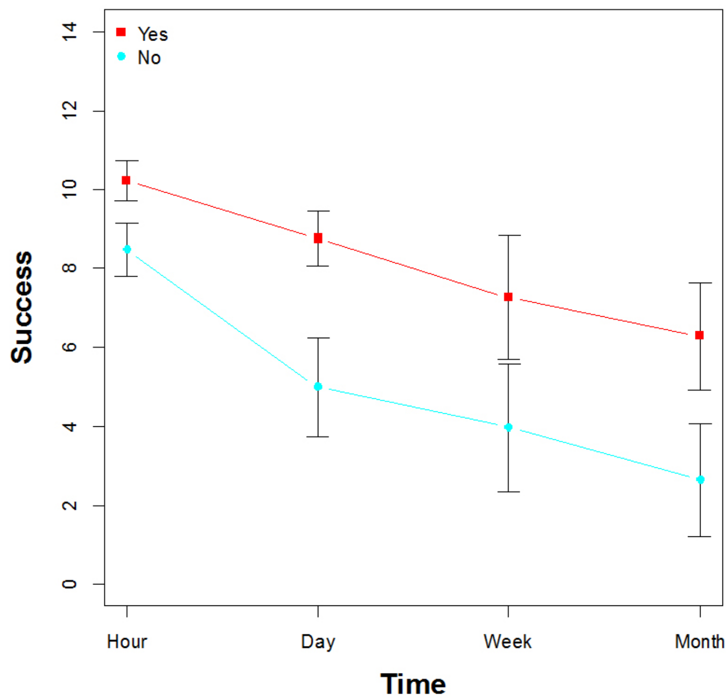
EXAMPLES

In an experiment conducted with expert tasters and people who had no experience tasting, they were taught to identify 15 types of wines from different regions. Variations in ability to ascertain the wine provenance over time was measured between experts and non-experts. For every time, each person assessed a large number of samples and the degree of success was recorded on a scale of 0 to 12.

Example 1 A dot plot is depicted with the argument *method=NULL* of the variable Success for all times grouped by the experience of tasters.



Example 2 The mean and the standard deviation of the variable Success is obtained for each time and group of tasters.



Value

A multiple dot or mean line charts for variable X qualitative are obtained.

References

Guisande, C. & Vaamonde, A. (2012) *Gráficos estadísticos y mapas con R*. Ediciones Díaz de Santos, Madrid, 367 pp.

Examples

```
## Not run:

#Example 1

data(Z15)

F39(data=Z15, varY="Success", FactorX="Time", group="Experience",
method=NULL, YLIM=c(0,14))

#Example 2

data(Z15)

F39(data=Z15, varY="Success", FactorX="Time", group="Experience",
YLIM=c(0,14))

## End(Not run)
```

F40 *MULTIPLE DOT OR MEAN WITH ERROR BARS LINE CHART FOR VARIABLE X QUALITATIVE WITH TEXT LABELS*

Description

It performs a multiple dot and mean with error bars scatter plots for variable X qualitative wiith text labels.

Usage

```
F40(data, varY, FactorX, group, type="b", label=NULL, method="mean",
dev="sd", ResetPAR=TRUE, PAR=NULL, order=NULL, OrderCat=NULL, LabelCat=NULL,
XLAB=NULL, YLAB=NULL, XLIM=NULL, YLIM=NULL, COLOR=NULL, COLORI="black",
ltyL=NULL, lwdL=1, PCH=NULL, CEX=1, LEGEND=NULL, AXIS=NULL,MTEXT= NULL, TEXT=NULL)
```

Arguments

`data`	Data file.
`varY`	Dependent variable.
`FactorX`	Qualitative independent variable.
`group`	Variable with the categories to be grouped.
`type`	Character string giving the type of plot desired. The following values are possible: "p" for points, "l" for lines, "b" for both points and lines, "c" for empty points joined by lines, "o" for overplotted points and lines, "s" and "S" for stair steps and "h" for histogram-like vertical lines. Finally, "n" does not produce any points or lines.
`label`	It allows to specify the characteristics of the text labels with the function text.
`method`	If it is not NULL, the average of each category of the independent variable *FactorX* is estimated with the "mean" or the "median".
`dev`	If the argument *method* is not NULL, the error bars may be estimated using the standard deviation ("sd") or the standard error ("se").
`ResetPAR`	If it is FALSE, the default condition of the function PAR is not placed and maintained those defined by the user in previous graphics.
`PAR`	It accesses the function PAR that allows to modify many different aspects of the graph.
`order`	If it is NULL the categories are ordered as found in the variable *FactorX*, if it is "increasing" are ordered from lesser to greater median or mean according to the method selected in the argument *method*, if it is "decreasing" are ordered from greater to lesser median or mean, if it is "alhaAZ" are ordered from A to Z and if it is "alphaZA" from Z to A.
`OrderCat`	It allows to specify a vector with the order in which the categories are shown. If this argument is specified, the argument *order* is not taken into account.

`LabelCat`	It allows to specify a vector with the names of the categories.
`XLAB`	Legend of the X axis.
`YLAB`	Legend of the Y axis.
`XLIM`	Vector with the limits of the X axis.
`YLIM`	Vector with the limits of the Y axis.
`COLOR`	Color of the symbols. It must be as many as different categories of the variable *group*.
`COLORI`	Color of the error bars.
`ltyL`	Type of the line chart (see figure of the argument *lty* in the function F1).
`lwdL`	Line width of the line chart.
`PCH`	Graphic symbol (see the description of the same argument in the function F1). It must be as many as different categories of the variable *group*.
`CEX`	Size of the symbols.
`LEGEND`	It allows to modify the legend of the graph.
`AXIS`	It allows to add axes to the graph.
`MTEXT`	It allows to add text on the margins of the graph.
`TEXT`	It allows to add text in any area of the inner part of the graph.

Details

FUNCTIONS

The plot is performed with the functions boxplot, points and arrows of base graphics package. For further details see Guisande & Vammonde (2012).

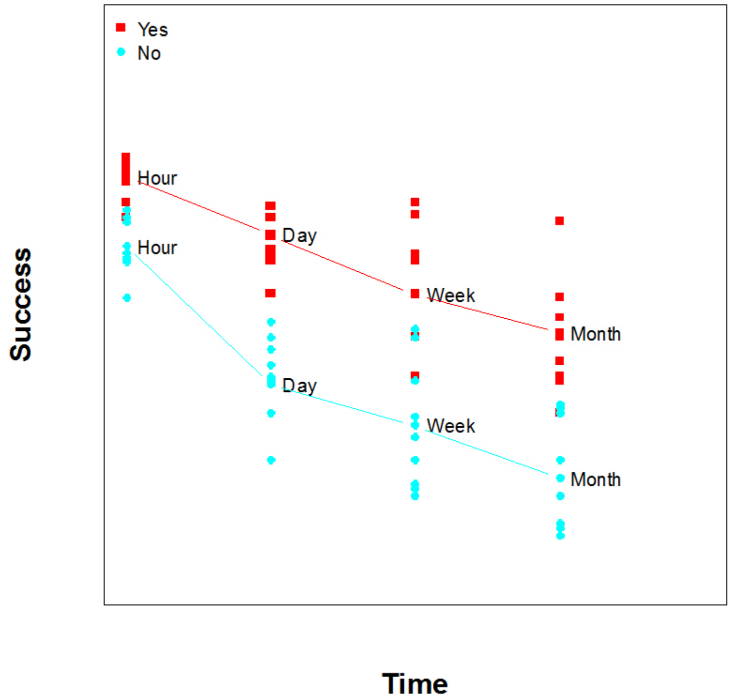
EXAMPLES

In an experiment conducted with expert tasters and people who had no experience tasting, they were taught to identify 15 types of wines from different regions.

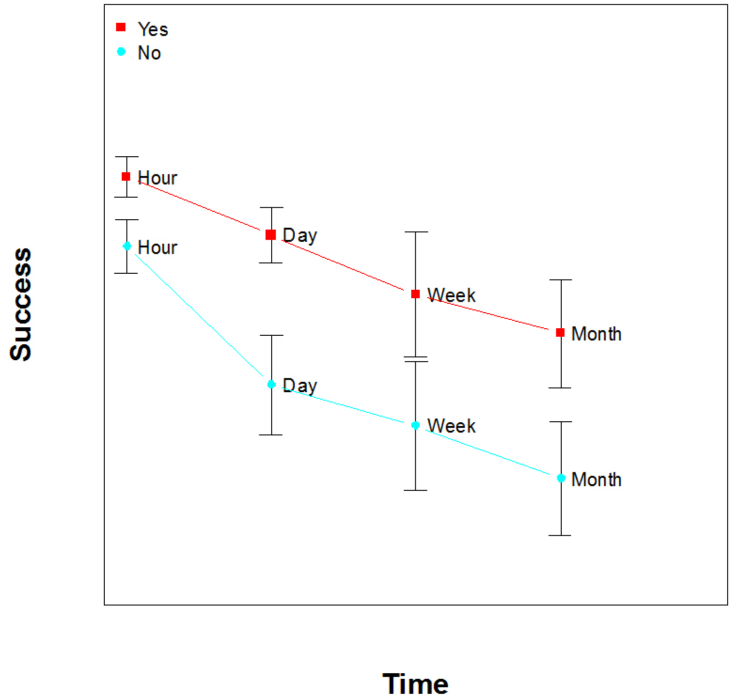
Variations in ability to ascertain the wine provenance over time (after one hour, one day, one week and one month) was measured between experts and non-experts.

For every time, each person assessed a large number of samples and the degree of success was recorded on a scale of 0 to 12.

Example 1 A dot plot is depicted with the argument *method=NULL* of the variable Success for all times grouped by the experience of tasters.



Example 2 The mean and the standard deviation of the variable Success is obtained for each time and group of tasters.



Value

A multiple dot or mean bars line chart with text labels are obtained.

References

Guisande, C. & Vaamonde, A. (2012) *Gráficos estadísticos y mapas con R*. Ediciones Díaz de Santos, Madrid, 367 pp.

Examples

```
## Not run:

#Example 1

data(Z15)

F40(data=Z15, varY="Success", FactorX="Time", group="Experience", YLIM=c(0,14),
method=NULL)

#Example 2

data(Z15)

F40(data=Z15, varY="Success", FactorX="Time", group="Experience", YLIM=c(0,14))

## End(Not run)
```

F41 *3D SCATTER PLOTS*

Description

It performs 3D scatter plots in panels, in one plot making the difference among categories and in one plot without distinguishing among categories.

Usage

```
F41(data, varZ,  varY, varX, group=NULL, panel=FALSE, CEX=1.2, PCH=NULL,
COLOR=NULL, ZLAB=NULL, YLAB=NULL, XLAB=NULL, ZLIM=NULL, YLIM=NULL,
XLIM=NULL, family="serif", cexaxis=1, cexZ=1.2, fontZ=2, rotZ=90, cexY=1.2,
fontY=2, rotY=-50, cexX=1.2, fontX=2, rotX=15, sz=20, sx=-70, sy=10, arrows=FALSE,
distance=0.8, LEGEND=NULL)
```

Arguments

`data`	Data file.
`varZ`	Variable Z.
`varY`	Variable Y.
`varX`	Variable X.
`group`	Variable with the categories to be grouped.
`panel`	If it is TRUE each category of the variable *group* is depicted in one panel.
`CEX`	Size of the symbols.
`PCH`	Graphic symbol (see the description of the same argument in the function F1). It must be as many as different categories of the variable *group*.
`COLOR`	Color of the symbols. It must be as many as different categories of the variable *group*.
`ZLAB`	Legend of the Z axis.
`YLAB`	Legend of the Y axis.
`XLAB`	Legend of the X axis.
`ZLIM`	Vector with the limits of the Z axis.
`YLIM`	Vector with the limits of the Y axis.
`XLIM`	Vector with the limits of the X axis.
`family`	It specifies the font of the plot.
`cexaxis`	Size of the axis labels.
`cexZ`	Size of the Z legend.
`fontZ`	A numeric value that defines the font of the Z legend. The value 1 is a normal type, 2 is written in bold, 3 is written in italics and 4 is written in italics and bold.

`rotZ`	Angle of Z legend.
`cexY`	Size of the Y legend.
`fontY`	A numeric value that defines the font of the Y legend. Options as mentioned in the argument *fontZ*.
`rotY`	Angle of Y legend.
`cexX`	Size of the X legend.
`fontX`	A numeric value that defines the font of the X legend. Options as mentioned in the argument *fontZ*.
`rotX`	Angle of X legend.
`sz`	Perspective of axis Z.
`sy`	Perspective of axis Y.
`sx`	Perspective of axis X.
`arrows`	If it is FALSE, tick marks and labels are used instead of arrows being drawn.
`distance`	It specifies the relative distance of the axis label from the bounding box.
`LEGEND`	It allows to modify the legend of the graph with the function grid_legend.

Details

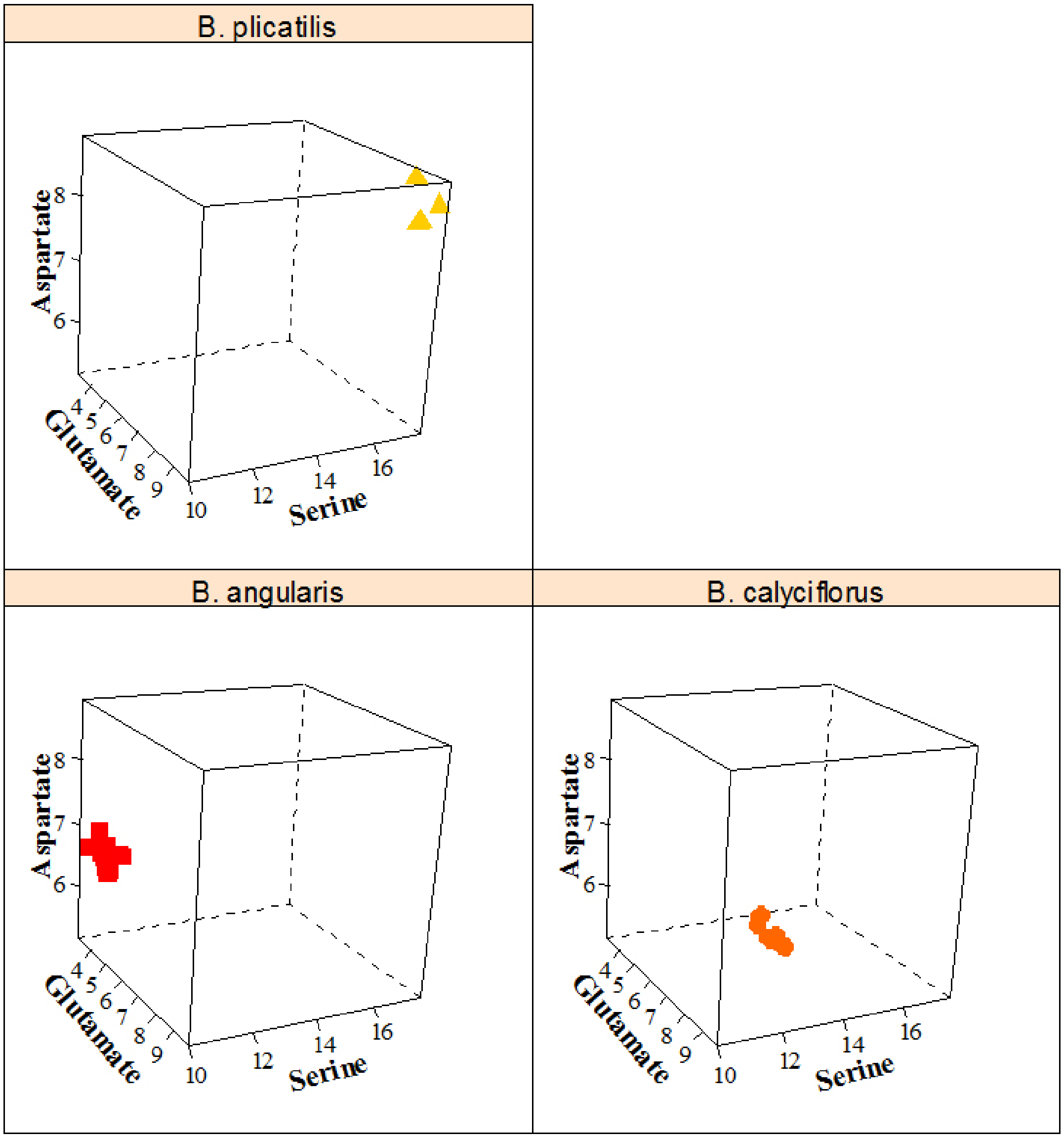
FUNCTIONS

The 3D plot was performed with the function lattice[cloud] of the package lattice (Sarkar, 2008). The function grid_legend of the package vcd (Meyer et al., 2006; 2015) was used to depict the legend. For further details see Guisande & Vammonde (2012).

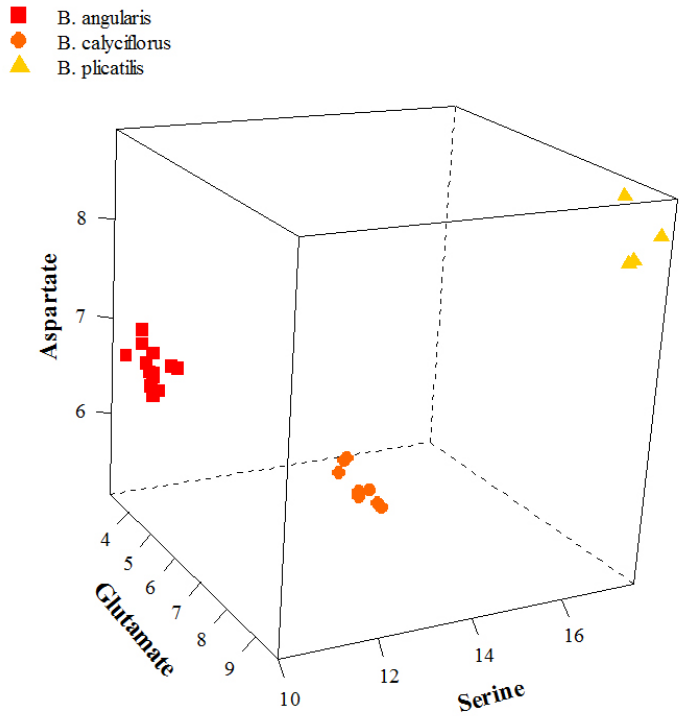
EXAMPLES

The data are the percentages of three amino acids in different species of rotifers obtained from ponds of Doñana National Park (Spain) (Guisande et al., 2008).

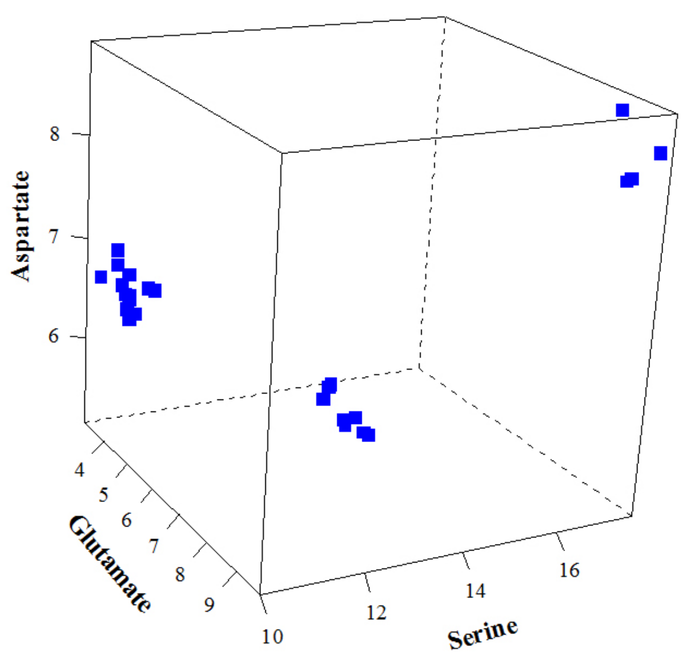
Example 1 Each species is shown in a panel with the argument *panel=TRUE*.



Example 2 All data are depicted in one plot but making the difference among species.



Example 3 All data are depicted in one plot without making differences among species.



Value

3D scatter plots are obtained.

References

Guisande, C., Granado-Lorencio, C, Toja, J. & León, D. (2008 Identification of the main factors in structuring rotifer community assemblages in ponds of Doñana National Park using the amino acid composition of the species. *Limnetica*, 27: 273-284.

Guisande, C. & Vaamonde, A. (2012) *Gráficos estadísticos y mapas con R*. Ediciones Díaz de Santos, Madrid, 367 pp.

Meyer, D., Zeileis, A. & Hornik, K. (2006) The strucplot framework: Visualizing multiway contingency tables with vcd. *Journal of Statistical Software*, 17: 1-48.

Meyer, D., Zeileis, A. & Hornik, K. (2015) Visualizing Categorical Data. R package version 1.4-1. Available at: https://CRAN.R-project.org/package=vcd.

Sarkar, D (2008) Lattice: Multivariate Data Visualization with R. Springer, New York. IBN 978-0-387-75968-5. http://lmdvr.r-forge.r-project.org.

Examples

```
## Not run:

#Example 1

data(Z17)

F41(data=Z17, varZ="Aspartate", varY="Glutamate", varX="Serine", group="Species",
panel=TRUE, cexaxis=0.8, cexZ=1, cexY=1,cexX=1)

#Example 2

data(Z17)

F41(data=Z17, varZ="Aspartate", varY="Glutamate", varX="Serine", group="Species")

#Example 3

data(Z17)

F41(data=Z17, varZ="Aspartate", varY="Glutamate", varX="Serine", COLOR="blue", PCH=15)

## End(Not run)
```

F42 *3D DYMANIC SCATTER PLOTS*

Description

It performs 3D dynamic scatter plots.

Usage

```
F42(data, varZ,  varY, varX, PLOT3D=NULL, CEX=2, COLOR="red", ZLAB=NULL,
YLAB=NULL, XLAB=NULL, ZLIM=NULL, YLIM=NULL, XLIM=NULL)
```

Arguments

`data`	Data file.
`varZ`	Variable Z.
`varY`	Variable Y.
`varX`	Variable X.
`PLOT3D`	It allows to modify the plot using the function plot3d.
`CEX`	Size of the symbols.
`COLOR`	Color of the symbols.
`ZLAB`	Legend of the Z axis.
`YLAB`	Legend of the Y axis.
`XLAB`	Legend of the X axis.
`ZLIM`	Vector with the limits of the Z axis.
`YLIM`	Vector with the limits of the Y axis.
`XLIM`	Vector with the limits of the X axis.

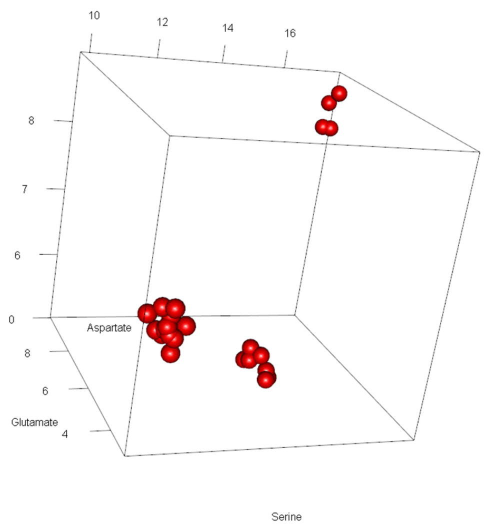
Details

FUNCTIONS

The 3D plot was performed with the function plot3d of the package rgl (Adler et al., 2015).

EXAMPLES

The data are the percentages of three amino acids in different species of rotifers obtained from ponds of Doñana National Park (Spain) (Guisande et al., 2008).



Value

3D dynamic scatter plot is obtained.

References

Adler, D., Murdoch, D. and others (2015) 3D Visualization Using OpenGL. R package version 0.95.1247. Available at: https://CRAN.R-project.org/package=rgl.

Guisande, C., Granado-Lorencio, C, Toja, J. & León, D. (2008 Identification of the main factors in structuring rotifer community assemblages in ponds of Doñana National Park using the amino acid composition of the species. *Limnetica*, 27: 273-284.

Examples

```
## Not run:

data(Z17)

F42(data=Z17, varZ="Aspartate", varY="Glutamate", varX="Serine")

## End(Not run)
```

F43 *VARIABLE SELECTION TO DISCRIMINATE BETWEEN TWO GROUPS (VARSEDIG)*

Description

This function performs an algorithm for selecting all variables that significantly discriminate between two groups.

Usage

```
F43(data, variables, group, group1, group2, method="overlap", stepwise=TRUE,
VARSEDIG=TRUE, minimum=TRUE, kernel="gaussian", cor=TRUE, ellipse=TRUE, convex=FALSE,
DPLOT=NULL, SCATTERPLOT=NULL, BIVTEST12=NULL, BIVTEST21=NULL, Pcol="red",
colbiv="lightblue", br=20, sub="", lty=1, lwd=2.5, ResetPAR=TRUE, PAR=NULL, XLABd=NULL,
YLABd=NULL, XLIMd=NULL, YLIMd=NULL, COLORd=NULL, COLORB=NULL, LEGENDd=NULL,
AXISd=NULL, MTEXTd= NULL, TEXTd=NULL, XLABs=NULL, YLABs=NULL, XLIMs=NULL, YLIMs=NULL,
PCHs=NULL, COLORs=NULL, LEGENDs=NULL, MTEXTs=NULL, TEXTs=NULL, LEGENDr=NULL,
MTEXTr= NULL, TEXTr=NULL, arrows=TRUE, larrow=1, ARROWS=NULL, TEXTa=NULL,
model="Model.rda", file1="Overlap.csv", file2="Coefficients.csv",
file3="Predictions.csv", file4="Polar coordinates", file="Output.txt",
na="NA", dec=",", row.names=FALSE)
```

Arguments

data	Data file.
variables	Variables to be selected.
group	Variable with the groups to be discriminated.
group1	First group.
group2	Second group.
method	Three different methods for prioritizing the variables according to their capacity for discrimination can be used. If the method is "overlap", a density curve is obtained for each variable and the overlap of the area under the curve between the two groups of the variable *group* is estimated for all variables. Those variables with lower overlap should have better discrimination capacities and, hence, all variables are ordered from lowest to highest overlap; in other words from the highest to lowest discrimination capacity. If the method is "Monte-Carlo", a Monte-Carlo test is performed comparing all values of group 1 with group 2, and all values of group 2 with 1. The variables are prioritized from the variable with the lowest mean of all p-values (highest discrimination capacity) to the variable with the highest mean of all p-values (lowest discrimination capacity). If the method is "logistic regression", then a binomial logistic regression is calculated and if the argument stepwise=TRUE (default option), then only significant variables are selected for further analyses with the regression performed by steps using the Akaike Information Criterion (AIC).
stepwise	If TRUE, the logistic regression is applied by steps, in order to eliminate those variables that are not significant. The Akaike information criterion (*AIC*) is used to define what are the variables that are excluded (see section *details* of the function XI5 of the package StatR for more details).
VARSEDIG	If it is TRUE, the variables are added for the estimation of polar coordinates in the priority order according to the method "overlap", "Monte-Carlo", or "logistic regression" and the variable is selected if it significantly contributes to discriminate between both groups. See details section for further information.
minimum	If it is TRUE, the algorithm is designed to find a significant discrimination between both groups with the minimum possible number of significant variables. Therefore, only the variables with higher discrimination capacity are selected.

If it is FALSE, the algorithm selects all significant variables,and not only those with higher discrimination capacity. This argument is only valid with the methods "Monte-Carlo" and "overlap" and it is useful in those cases that discrimination between the groups is difficult and requires to include as many as variables as possible.

`kernel` A character string giving the smoothing kernel to be used for estimating the overlap of the area under the curve between groups. This must be one of "gaussian", "rectangular", "triangular", "epanechnikov", "biweight", "cosine" or "optcosine". For further details about the estimation of the density curve see the details section of the function density of base stats package.

`cor` If it is TRUE the variables are ordered according to the correlation between them when estimating the polar coordinates. Therefore, the next variable to another variable is the one that has a greater positive correlation.

`ellipse` If it is TRUE the ellipses with the levels of significance to the 0.5 (inner ellipse) and 0.95 (outer ellipse) of each category of the variable *group* is depicted. These levels of significance can be modified by entering the function scatterplot using the argument *SCATTERPLOT* and modifying the argument *levels=c(0.5,0.95)*.

`convex` If it is TRUE the convex hull is depicted for each category.

`DPLOT` It allows to specify the characteristics of the function plot.default of the density plot.

`SCATTERPLOT` It accesses the function scatterplot of the car package, with the graph *biplot* that performs the X an Y polar coordinates.

`BIVTEST12` It accesses the function biv.test of the package adehabitatHS, which performs the bivariate plot that displays the results of a bivariate randomisation test. From all values of group 2, it shows the value with higher probability to belong to group 1.

`BIVTEST21` As in the argument *BIVTEST12*, but from all values of group 1, it shows the value with higher probability to belong to group 2.

`Pcol` Color or name for the observation of group 2 in the BIVTEST12 plot and for the value of group 1 in the BIVTEST21 plot.

`colbiv` Color or name of all values of group 1 in the BIVTEST12 plot and all values of group 2 in the BIVTEST21 plot.

`br` Numbers of breaks of the histograms in the BIVTEST plots.

`sub` Title in the BIVTEST plots.

`lty` Type of line of the density curve for each group. If it is a vector, it must be as many as different categories of the variable *group*. See the description of the same argument in the function F1.

`lwd` Line width relative to the default (default=1), so 2 is twice as wide of the density curve.

`ResetPAR` If it is FALSE, the default condition of the function PAR is not placed and maintained those defined by the user in previous graphics.

`PAR` It accesses the function PAR that allows to modify many different aspects of the graph.

XLABd	Legend of the X axis in the density plot.
YLABd	Legend of the Y axis in the density plot.
XLIMd	Vector with the limits of the X axis in the density plot.
YLIMd	Vector with the limits of the Y axis in the density plot.
COLORd	Color of the density curves in the density plot. It must be as many as different categories of the variable *group*. As the color has transparency, the plot must be copy as bitmap and not metafile.
COLORB	Color of the lines in the density plot. It must be as many as different categories of the variable *group*.
LEGENDd	It allows to modify the legend of the density plot. If it is FALSE the legend is not shown.
AXISd	It allows to add axes to the density plot.
MTEXTd	It allows to add text on the margins of the density plot.
TEXTd	It allows to add text in any area of the inner part of the density plot.
XLABs	Legend of the X axis in the scatterplot.
YLABs	Legend of the Y axis in the scatterplot.
XLIMs	Vector with the limits of the X axis in the scatterplot.
YLIMs	Vector with the limits of the Y axis in the scatterplot.
PCHs	Vector with the symbols of the scatterplot, that should be as many as different groups the variable *group* has. If NULL, they are automatically calculated starting with the symbol 15.
COLORs	It allows to modify the colors of the scatterplot. It must be as many as different categories of the variable *group*.
LEGENDs	It allows to modify the legend of the scatterplot.
MTEXTs	It allows to add text on the margins of the scatterplot.
TEXTs	It allows to add text in any area of the inner part of the scatterplot.
LEGENDr	It allows to modify the legend of the BIVTEST plot. If it is FALSE the legend is not shown.
MTEXTr	It allows to add text on the margins of the BIVTEST plot.
TEXTr	It allows to add text in any area of the inner part of the BIVTEST plot.
arrows	If it is TRUE the arrows are shown in the scatterplot with the polar coordinates. These arrows show the vector of the variables selected when calculating the polar coordinates.
larrow	It modifies the length of the arrows.
ARROWS	It accesses the function Arrows of the package IDPmisc, which performs the arrows.
TEXTa	It allows to modify the labels at the end of the arrows.
model	Filename with the model of the binomial logistic regression.
file1	CSV FILE. Filename with the overlap of the area under the curve between both categories for all variables.

`file2`	CSV FILES. Filename with regression coefficients of the binomial logistic regression.
`file3`	CSV FILES. Filename with the predictions of the binomial logistic regression.
`file4`	CSV FILES. Filename with the polar coordinates for both categories of the variable *group*.
`file`	TXT FILE. Name of the output file with the results of the binomial logistic regression, the variables that significantly discriminate between the two groups and Euclidean distance between the two groups considering the polar coordinates.
`na`	CSV FILE. Text that is used in the cells without data.
`dec`	CSV FILE. It defines if the comma "," is used as decimal separator or the dot ".".
`row.names`	CSV FILE. Logical value that defines if identifiers are put in rows or a vector with a text for each of the rows.

Details

Classification methods such as logistic regression and discriminant analysis are probably the best available methods for the identification of the variables optimally able to predict group membership (Guisande et al. 2011; Guisande & Vaamonde 2012). Classification and Regression Trees (CARTs) are useful for identifying the variables that best discriminate groups, it is impossible using those methods to test the significance of the variables or to predict group membership (Guisande & Vaamonde 2012).

There are three advantages of logistic regression over discriminant analysis (Guisande et al., 2011): 1) the logistic regression is much more relaxed and flexible in its assumptions than the discriminant analysis because, unlike the discriminant analysis, the logistic regression does not have the requirements of the independent variables to be normally distributed, linearly related, nor equal variance within each group; 2) logistic regression may be more powerful and efficient analytic strategy if there are qualitative variables among predictors; 3) it is possible to use a stepwise logistic regression and, therefore, to select only those variables that significantly discriminate between groups. Discriminant analysis, however, does not have a statistical test of the coefficients of individual independent variables comparable to logistic regression, so it is not possible to test significance of variables and, therefore, to select only the variables that significantly predict group membership. Actually, to include variables with low discrimination capacity leads to reduce the identification success of the discriminant analysis.

The disadvantages of logistic regression are mainly also three: 1) the lack of a graphical representation of the results; 2) to evaluate the predictability of the final model chosen from the analysis it is not enough with the information about the percentage of cases correctly identified; 3) when the assumptions mentioned above regarding the distribution of predictors are met, discriminant function analysis may be more powerful and efficient analytic strategy than logistic regression (Tabachnick & Fidell, 1996)

This function performs an algorithm for: 1) prioritizing the variables by their discrimination capacity using three different methods, 2) selecting only those variables that significantly discriminate between two groups, 3) evaluating the predictability of the final model chosen with a Monte-Carlo test and 4) the results are graphically depicted in four different plots.

1. Prioritizing the variables by their discrimination capacity

Three different methods for prioritizing the variables according to their capacity for discrimination can be used.

1. If the argument *method="overlap"*, a density curve is obtained for each variable and the overlap of the area under the curve between the two groups is estimated for all variables. Those variables with lower overlap should have better discrimination capacities and, hence, all variables are ordered from lowest to highest overlap; in other words from the highest to lowest discrimination capacity. This information is saved in *file1="Overlap.csv"*.

2. If the method is "Monte-Carlo", a Monte-Carlo test is performed comparing all values of group 1 with group 2, and all values of group 2 with 1. The variables are prioritized from the variable with the lowest mean of all p-values (highest discrimination capacity) to the variable with the highest mean of all p-values (lowest discrimination capacity).

3. If the argument *method="logistic regression"*, then a binomial logistic regression is calculated and if the argument stepwise=TRUE (default option), then only significant variables are selected for further analyses with the regression performed by steps using the Akaike Information Criterion (AIC). The model of the regression is saved in *model="Model.rda"*, the coefficients in *file2="Coefficients.csv"* and the predictions of the regression in *file3="Predictions.csv"*.

2. Polar coordinates

All variables are transformed to a scale ranged between -1 and 1. For each value the X and Y polar coordinates are estimated using the following equations:

$$X = \sum_{i=1}^{n} |z_j| cos(\alpha) \quad Y = \sum_{i=1}^{n} |z_j| sin(\alpha)$$

where *z* is the value of the variable *j* and *n* the number of variables.

Each variable is assigned an angle (α). The increment value of the angle is always $\frac{360}{n*2}$. If for instance the number of variables is 5, the increment angle is 36. Therefore, for the first variable if the value is ≥ 0 the α value is 36 and if the value is < 0 the value is 36+180, for the second variable if the value is ≥ 0 the α value is 36+36 and if the value is < 0 the value is 36+36+180, etc. Conversion of degrees to radians angle is carried out assuming that 1 degree = 0.0174532925 radians.

The order of the variables is consequently important because a different alpha value is assigned. If the argument *cor=TRUE*, this order is established calculating the correlation matrix of the variables and by ordering them such that each variable is followed by the variable to which it is highly correlated. The goal is to favor a larger dispersion of the data in the resulting polar coordinates system.

3. Algorithm for variables selection

The variables are added for the estimation of polar coordinates in the priority order according to *method="overlap"*, *method="Monte-Carlo"* or *method="logistic regression"*.

Mean X and Y polar coordinates are estimated for both groups and via these means the Euclidean distance is calculated between both groups.

In the case of the X and Y polar coordinates, a Monte-Carlo test is used for testing the statistical hypothesis if a value of one group is significantly higher or lower that the values of the other group. The test is performed for both X and Y polar coordinates and compares all values of one group with those of the other group. For instance, when all values of group 1 are compared with group 2, and the mean X polar coordinate of group 1 is higher than the one of group 2, the alternative hypothesis of the Monte-Carlo test is *greater*, and the p-value is estimated as (number of random values equal to or greater than the observed one + 1)/(number of permutations + 1). The null hypothesis is rejected if the p-value is less than the significance level. If the mean X polar coordinate of group 1 is lower than the one of group 2, the alternative hypothesis is *smaller*, a p-value is estimated as (number of random values equal to or less than the observed one + 1)/(number of permutations + 1). Again, the null hypothesis is rejected if the p-value is less than the significance level. The same process is applied when comparing all values of group 2 with those of group 1.

A variable is selected if it both: 1) contributes to increase Euclidean distance between both groups compared with the Euclidean distance obtained with the set of previously selected variables; and 2) the p-values of the Monte-Carlo test for X and Y coordinates when comparing both group 1 with group 2 and group 2 with group 1 are smaller than the p-values obtained with the set of previous selected variables. Therefore, from the pool of all independent variables, only those variables with the highest significant contribution to discriminating between both groups are selected.

The variables selected are saved in the *file="Output.txt"* and the polar coordinates of all values of both groups estimated with the variables selected are depicted in a scatterplot and saved in *file4="Polar coordinates.csv"*.

At the end of the process, it is selected the value with the highest p-value. Therefore, if this p-value is close or lower than the significance level of 0.05, it may be concluded that any of the values of one group may be identified as belonging to the other group.

Two plots are obtained with the value of the group 1 with the highest p-value of belonging to group 2 and the value of the group 2 with the highest p-value of belonging to group 1, respectively. In both plots, the x-axis corresponds to the X polar coordinates and the y-axis corresponds to Y polar coordinates.

If p-value is close or lower than 0.05 for X or Y polar coordinates, but in both cases when comparing group 1 with group 2 and group 2 with 1, it may be concluded that the variables selected are significantly contributing to discriminate between both groups, so with these variables is possible to achieve a 100% of identification success when predicting group membership.

FUNCTIONS

The density plot is performed with the function plot.default of base graphics package. The density curve is estimated with the function density of base stats package. The area under the curve is estimated with the function auc of the package kulife (Ekstrom et al., 2015). The random test was performed with the function as.randtest of the package ade4 (Chessel et al., 2004; Dray et al., 2007; 2015). The bivariate plot that displays the results of a bivariate randomisation test, for which the p-values are computed with the function as.randtest (one-sided tests), was performed with the function biv.test of the package adehabitatHS (Calenge, 2006; 2015). The arrows are depicted with the function Arrows of the package IDPmisc (Locher & Ruckstuhl, 2014). The scatterplot is performed with the function scatterplot of the car package (Fox & Weisberg, 2011; Fox et al., 2014). The convex hull is estimated with the function chull of the package grDevices.

EXAMPLES

For the example, morphometric data of three families of freshwater fishes, as the distance from the origin of the dorsal fin to the origin of the anal fin (M13), the length of the dorsal fin base (M12), body height (M11), etc., are used. For details see Guisande et al. (2010).

Figure shows the plots obtained with VARSEDIG, in an example comparing the species *Moenkhausia dichroura* and *Moenkhausia oligolepis*.

The variables that better discriminate between both species are the M26 (interorbital width) and M11 (distance from the dorsal-fin origin to the dorsal limit of the pelvic-fin base). Between these two variables, a density plot is depicted for the quantitative variable with lower overlap between both groups and, thus, the highest discrimination capacity: in this example M26 (Figure 1A). A density plot for other variables may be depicted using the function F18 of PlotsR.

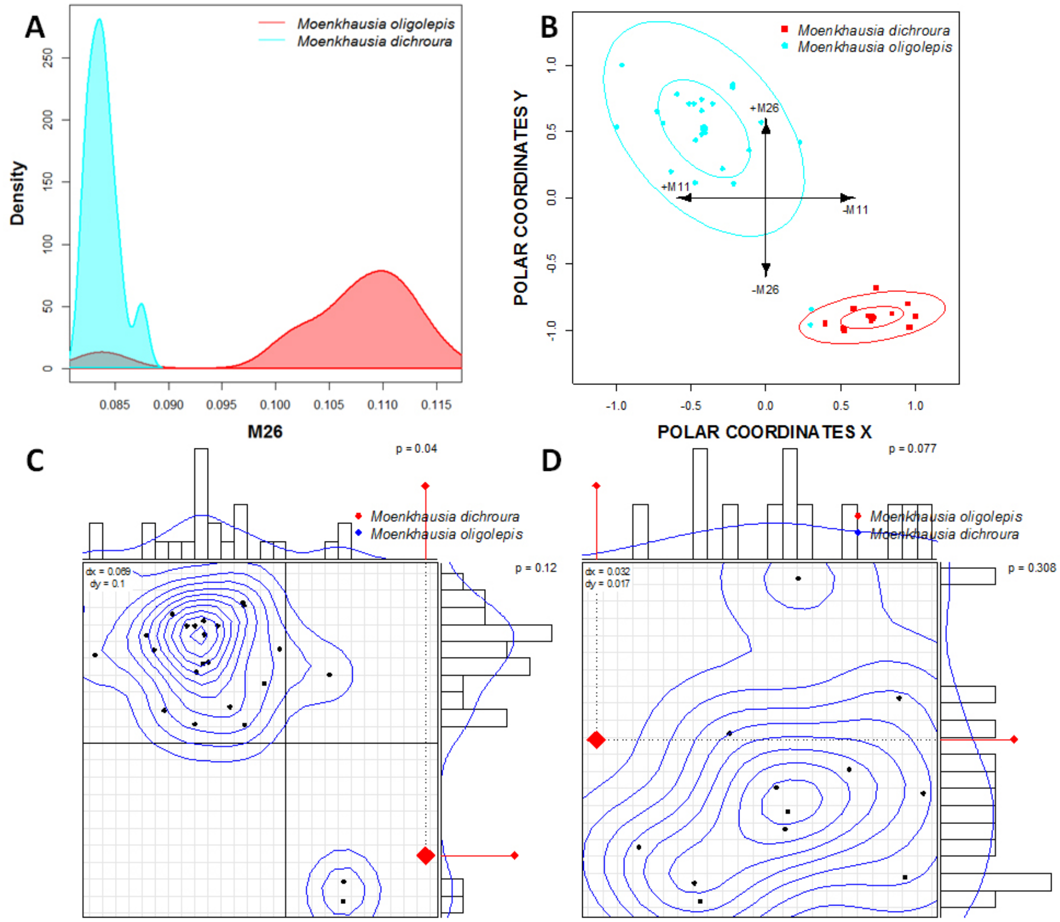
Figure 1B shows the scatterplot of the polar coordinates obtained for both species using variables M26 and M11. The arrows show the vector of the variables with both of these variables higher in *M. oligolepis*.

This example illustrates that the VARSEDIG algorithm is not only useful for identifying the variables that better discriminate between two taxa, but also may be informative when it comes to finding misidentified individuals. In the example, it appears that two individuals identified as *M. oligolepis* are *M. dichroura* (Figure 1B).

Figure 1C displays the results of a bivariate randomisation test. From all individuals of the species *M. dichroura*, the figure shows the individual of *M. dichroura* (red point) with higher probability to be identified as belonging to the M. oligolepis. Kernel density is estimated to indicate the contours of the distribution of randomised values. The two marginal histograms correspond to the univariate tests on each axis, for which the p-values (one-sided tests) are computed. As p-value is lower than 0.05 for X axis (p = 0.04), the null hypothesis is rejected. Consequently the X polar coordinates of all individuals of the of the species *M. dichroura* are significantly different than those of the species *M. oligolepis* and, therefore, none of the individuals designated as *M. dichroura* may be identified as belonging to the species *M. oligolepis*.

Figure 1D also displays the results of a bivariate randomisation test but, in this case, from all individuals of the species *M. oligolepis*, the figure shows the individual (red point) with higher probability to belong to the species *M. dichroura*. Both p-values are higher than 0.05, so null hypothesis is accepted for both X and Y polar coordinates. This that some individuals of the species *M. oligolepis* may be identified as belonging to the species *M. dichroura*.

Example 1



It is not necessary a p-value lower than 0.05 for both X and Y, but it is just necessary and p-value lower than 0.05 for X or Y when comparing both group 1 with 2 and group 2 with 1. Therefore, if p-value is close or lower than the significance level of 0.05 for X or Y polar coordinates in both cases comparing group 1 with 2 and group 2 with 1, it would mean a 100% of identification success between both groups. In this example, however, with the variables M16 and M11 is not possible to predict group membership with a 100% of accuracy because, although none of the individuals of the species *M. dichroura* may be identified as belonging to the species *M. oligolepis*, some individuals of the species *M. oligolepis* may be identified as belonging to the species *M. dichroura*. The failure to reach 100% may be due to the possible misidentification of two individuals of *M. dichroura* as *M. oligolepis*.

Value

It is depicted 4 plots: 1) a density plot with the overlap of the area under de curve between the two groups for the variable that better discriminates between both groups, 2) a scatter plot with the polar coordinates for both groups, 3) a bivariate plot that shows from all values of group 2 the value with higher probability to belong to group 1, and 4) a bivariate plot that shows from all values of group 1 the value with higher probability to belong to group 2. Moreover, 5 files are saved: 1) overlap of the area under the curve between both categories for all variables, 2) regression coefficients of the binomial logistic regression, 3) predictions of the binomial logistic regression, 4) polar coordinates for both categories of the variable *group*, and 5) a TXT file with the results of the binomial logistic regression, the variables that better discriminate between the two groups and the Euclidean distance between groups considering the polar coordinates.

References

Calenge, C. (2006) The package adehabitat for the R software: a tool for the analysis of space and habitat use by animals. *Ecological Modelling*, 197, 516-519.

Calenge, C. (2016) Analysis of Habitat Selection by Animals. R package version 0.3.12. Available at: https://CRAN.R-project.org/package=adehabitatHS.

Chessel, D., Dufour, A.B. and Thioulouse, J. (2004) The ade4 package-I- One-table methods. *R News*, 4, 5-10.

Dray, S. & Dufour, A.B. (2007) The ade4 package: implementing the duality diagram for ecologists. *Journal of Statistical Software*, 22(4), 1-20.

Dray, S. & Dufour, A.B. and Chessel, D. (2007) The ade4 package-II: Two-table and K-table methods. *R News*, 7(2), 47-52.

Dray, S., Dufour, A-B. & Thioulouse, J. (2015) Analysis of Ecological Data : Exploratory and Euclidean Methods in Environmental Sciences. R package version 1.7-2. Available at: https://CRAN.R-project.org/package=ade4.

Ekstrom, C., Skovgaard, Ib M. & Martinussen, T.(2015) Datasets and functions from the (now non-existing). R package version 0.1-14. Available at: https://CRAN.R-project.org/package=kulife.

Fox, J. & Weisberg, S. (2011) An R Companion to Applied Regression, Second Edition. Thousand Oaks CA: Sage. http://socialsciences.mcmaster.ca/jfox/Books/Companion/.

Fox, J., Weisberg, S., Adler, D., Bates, D., Baud-Bovy, G., Ellison, S., Firth, D., Friendly, M., Gorjanc, G., Graves, S., Heiberger, R., Laboissiere, R., Monette, G., Murdoch, D., Nilsson, H., Ogle, D., Ripley, B., Venables, W. & Zeileis, A. (2014) Companion to Applied Regression. R package version 2.0-20. Available at: https://CRAN.R-project.org/package=car.

Guisande, C., Manjarrés-Hernández, A., Pelayo-Villamil, P., Granado-Lorencio, C., Riveiro, I., Acuña, A., Prieto-Piraquive, E., Janeiro, E., Matías, J.M., Patti, C., Patti, B., Mazzola, S., Jiménez, S., Duque, V. & Salmerón, F. (2010) IPez: An expert system for the taxonomic identification of fishes based on machine learning techniques. *Fisheries Research*, 102, 240-247.

Guisande, C., Vaamonde, A. & Barreiro, A. (2011) *Tratamiento de datos con R, SPSS y STATISTICA*. Ediciones Díaz de Santos, Madrid, 978 pp.

Guisande, C. & Vaamonde, A. (2012) *Gráficos estadísticos y mapas con R*. Ediciones Díaz de Santos, Madrid, 367 pp.

Locher, R. & Ruckstuhl, A. (2014) Utilities of Institute of Data Analyses and Process Design. R package version 1.1.17. Available at: https://CRAN.R-project.org/package=IDPmisc.

Tabachnick, B.G. & Fidell, L.S. (1996) *Using Multivariate Statistics*. NY, HarperCollins.

Examples

```
## Not run:

data(Z1)

F43(data = Z1 , variables = c("M2","M3","M4","M5","M6","M7","M8","M9","M10",
"M11","M12","M13","M14","M15","M16","M17","M18","M19","M20","M21","M22","M23",
"M24","M25","M26","M27","M28"), group="Species" , group1= "Moenkhausia oligolepis",
group2="Moenkhausia dichroura", LEGENDd=c("x='topright'", "legend = dati",
"col = COLORB", "lty=lty", "bty='n'", "cex=1.2", "text.font= 3"),
LEGENDs=c("x='topright'", "legend=unique(datosF[,'Group'])", "col = color1",
"pch = pcht", "bty='n'", "cex=1.2", "text.font=3"), LEGENDr=c("x='topright'",
"legend = dati", "col=col", "pch= c(16,16)", "bty='n'", "cex=1.2", "text.font=3"),
XLIMs=c(-1.2,1.2), YLIMs=c(-1.3,1.3), BIVTEST12=c("br=br", "cex=1.1",
"col=colbiv", "sub=sub", "Pcol=Pcol"), BIVTEST21=c("br=br", "cex=1.1",
"col=colbiv", "sub=sub", "Pcol=Pcol"), colbiv="blue")

## End(Not run)
```

F44 *MONTE-CARLO TEST FOR ONE VARIABLE*

Description

A Monte-Carlo test is performed for testing the hypothesis, in one variable, if an observation is significantly greater or lower than a set of values belonging to a group.

Usage

```
F44(data, variable, group, group1, row, ResetPAR=TRUE,  PAR=NULL, HIST=NULL,
colorp="red", pch=18, cex=2, colorb="lightblue", breaks=10, LEGEND=NULL,
AXIS=NULL, MTEXT= NULL, TEXT=NULL, file="Output.txt")
```

Arguments

`data`	Data file.
`variable`	Variable to be selected.
`group`	Variable with the groups to be compared.
`group1`	Group to be selected within the variable *group*.
`row`	Row number of the observation to be compared with the *group1*.
`ResetPAR`	If it is FALSE, the default condition of the function PAR is not placed and maintained those defined by the user in previous graphics.
`PAR`	It accesses the function PAR that allows to modify many different aspects of the graph.
`HIST`	It allows to specify the characteristics of the function hist.
`colorp`	Color of the point of the observation.

pch	Graphic symbol of the observation (see the description of the same argument in the function F1).
cex	Size of the symbol of the observation.
colorb	Color of the bars in the histogram.
breaks	Number of bars of the histogram.
LEGEND	It allows to modify the legend of the histogram.
AXIS	It allows to add axes to the histogram.
MTEXT	It allows to add text on the margins of the histogram.
TEXT	It allows to add text in any area of the inner part of the histogram.
file	TXT FILE. Name of the output file with the results of the Monte-Carlo test.

Details

In the Monte-Carlo test, if the alternative hypothesis is *greater*, a p-value is estimated as: (number of random values equal to or greater than the observed one + 1)/(number of permutations + 1). The null hypothesis is rejected if the p-value is less than the significance level.

If the alternative hypothesis is *smaller*, a pvalue is estimated as: (number of random values equal to or less than the observed one + 1)/(number of permutations + 1). Again, the null hypothesis is rejected if the p-value is less than the significance level.

FUNCTIONS

The histogram is performed with the function hist of base graphics package.

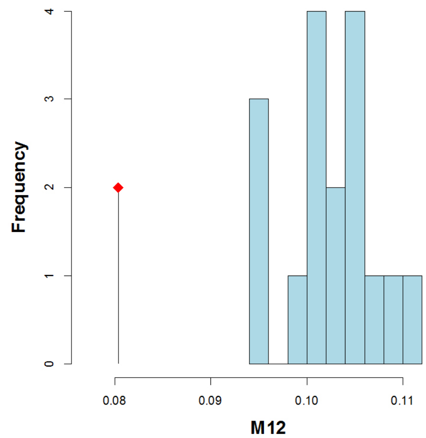
The Monte-Carlo test was performed with the function as.randtest of the package ade4 (Chessel et al., 2004; Dray et al., 2007; 2015).

EXAMPLES

For the example, morphometric data of three families of freshwater fishes, as the distance from the origin of the dorsal fin to the origin of the anal fin (M13), the length of the dorsal fin base (M12), body height (M11), etc., are used. For details see Guisande et al. (2010).

In the example the morphometric variable M12 is compared between the observation of the row number 54, a individual of the species *Triportheus magdalenae*, and all values of the species *Triportheus angulatus*.

In the histogram, the bars are the frequency of the variable M12 for the species *Triportheus angulatus* and the red point is the observation of the species *Triportheus magdalenae*.



When the alternative hypothesis is being smaller, the p-value is 0.055 and, therefore, it may be concluded that the observation of the species *Triportheus magdalenae* is significantly smaller than the individuals of the species *Triportheus angulatus* for the variable M12. However, when the alternative hypothesis is being greater, the p-value is 1 and, therefore, it may be concluded that the observation of the species *Triportheus magdalenae* is not significantly greater than the individuals of the species *Triportheus angulatus* for the variable M12.

```
[1] "Species"                "Triportheus magdalenae"
[1] "Observation row:" "54"
[1] "Observation value:" "0.0804"
[1] ""
[1] "ALTERNATIVE HYPOTHESIS: PROBABILITY OF BEING SMALLER"
Monte-Carlo test
Call: as.randtest(sim = as.numeric(grupo1[, 1]), obs = as.numeric(datos[row,
    1]), alter = "less")

Observation: 0.0804

Based on 17 replicates
Simulated p-value: 0.05555556
Alternative hypothesis: less

      Std.Obs   Expectation      Variance
-4.675554e+00  1.025235e-01  2.238941e-05
[1] ""
[1] "ALTERNATIVE HYPOTHESIS: PROBABILITY OF BEING GREATER"
Monte-Carlo test
Call: as.randtest(sim = as.numeric(grupo1[, 1]), obs = as.numeric(datos[row,
    1]), alter = "greater")

Observation: 0.0804

Based on 17 replicates
Simulated p-value: 1
Alternative hypothesis: greater

      Std.Obs   Expectation      Variance
-4.675554e+00  1.025235e-01  2.238941e-05
```

Value

It is depicted a histogram with the frequencies of the *group1* and the point of the observation. It is saved a TXT file with the results of the Monte-Carlo test.

References

Chessel, D. and Dufour, A.B. and Thioulouse, J. (2004) The ade4 package-I- One-table methods. *R News*, 4, 5-10.

Dray, S. & Dufour, A.B. (2007) The ade4 package: implementing the duality diagram for ecologists. *Journal of Statistical Software*, 22(4), 1-20.

Dray, S. & Dufour, A.B. and Chessel, D. (2007) The ade4 package-II: Two-table and K-table methods. *R News*, 7(2), 47-52.

Dray , S., Dufour , A-B. & Thioulouse , J. (2015) Analysis of Ecological Data : Exploratory and Euclidean Methods in Environmental Sciences. R package version 1.7-2. Available at: https://CRAN.R-project.org/package=ade4.

Guisande, C., Manjarrés-Hernández, A., Pelayo-Villamil, P., Granado-Lorencio, C., Riveiro, I., Acuña, A., Prieto-Piraquive, E., Janeiro, E., Matías, J.M., Patti, C., Patti, B., Mazzola, S., Jiménez, S., Duque, V. & Salmerón, F. (2010) IPez: An expert system for the taxonomic identification of fishes based on machine learning techniques. *Fisheries Research*, 102, 240-247.

Examples

```
## Not run:

data(Z1)

F44(data=Z1, variable="M12", group="Species", group1="Triportheus angulatus", row=54)

## End(Not run)
```

F45 *MONTE-CARLO TEST FOR TWO VARIABLES*

Description

A Monte-Carlo test is performed for testing the hypothesis, in two variable, if an observation is significantly greater or lower than a set of values belonging to a group.

Usage

```
F45(data, variable1, variable2, group, group1, row, ResetPAR=TRUE,
PAR=NULL, BIVTEST=NULL, Pcol="red", colbiv="lightblue", br=20, sub="", LEGEND=NULL,
AXIS=NULL, MTEXT= NULL, TEXT=NULL, TEXTX=NULL, TEXTY=NULL)
```

Arguments

`data`	Data file.
`variable1`	Variable 1 to be selected.
`variable2`	Variable 2 to be selected.
`group`	Variable with the groups to be compared.
`group1`	Group to be selected within the variable *group*.
`row`	Row number of the observation to be compared with the *group1*.
`ResetPAR`	If it is FALSE, the default condition of the function PAR is not placed and maintained those defined by the user in previous graphics.

`PAR`	It accesses the function PAR that allows to modify many different aspects of the graph.
`BIVTEST`	It accesses the function biv.test of the package adehabitatHS, which performs the bivariate plot that displays the results of a bivariate Monte-Carlo test.
`Pcol`	Color or name for the observation in the BIVTEST plot.
`colbiv`	Color or name of all values of group 1 in the BIVTEST plot.
`br`	Numbers of breaks of the histograms in the BIVTEST plot.
`sub`	Title in the BIVTEST plot.
`LEGEND`	It allows to modify the legend of the BIVTEST plot.
`AXIS`	It allows to add axes to the BIVTEST plot.
`MTEXT`	It allows to add text on the margins of BIVTEST plot.
`TEXT`	It allows to add text in any area of the inner part of the BIVTEST plot.
`TEXTX`	It allows to modify the lengend of axis X.
`TEXTY`	It allows to modify the lengend of axis Y.

Details

In the Monte-Carlo test, if the alternative hypothesis is *greater*, a p-value is estimated as: (number of random values equal to or greater than the observed one + 1)/(number of permutations + 1). The null hypothesis is rejected if the p-value is less than the significance level.

If the alternative hypothesis is *smaller*, a pvalue is estimated as: (number of random values equal to or less than the observed one + 1)/(number of permutations + 1). Again, the null hypothesis is rejected if the p-value is less than the significance level.

FUNCTIONS

The Monte-Carlo test was performed with the function as.randtest of the package ade4 (Chessel et al., 2004; Dray et al., 2007; 2015). The bivariate plot that displays the results of a bivariate Monte-Carlo test, for which the p-values are computed with the function as.randtest (one-sided tests), was performed with the function biv.test of the package adehabitatHS (Calenge, 2006; 2015).

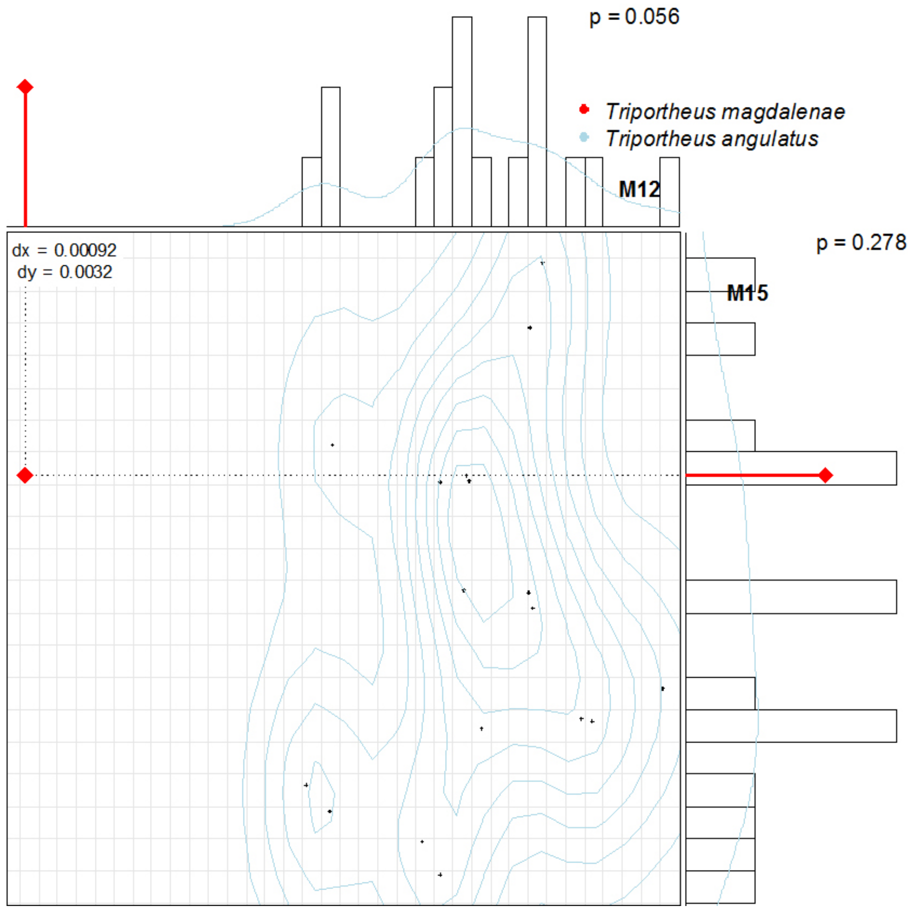
EXAMPLES

For the example, morphometric data of three families of freshwater fishes, as the distance from the origin of the dorsal fin to the origin of the anal fin (M13), the length of the dorsal fin base (M12), body height (M11), etc., are used. For details see Guisande et al. (2010).

In the example the morphometric variables M12 and M15 are compared between the observation of the row number 54, a individual of the species *Triportheus magdalenae*, and all values of the species *Triportheus angulatus*.

For the variable M15 p = 0.278 and, therefore, there are not significant differences between the observation of the species *Triportheus magdalenae* and the individuals of the species *Triportheus angulatus*.

However, for the variable M12 p = 0.056 and, therefore, it may be concluded that the observation is significantly different than all individuals of the species *Triportheus angulatus*.



Value

It is depicted a bivariate plot that displays the results of a bivariate Monte-Carlo test.

References

Calenge, C. (2006) The package adehabitat for the R software: a tool for the analysis of space and habitat use by animals. *Ecological Modelling*, 197, 516-519.

Calenge, C. (2015) Analysis of Habitat Selection by Animals. R package version 0.3-12. Available at: https://CRAN.R-project.org/package=adehabitatHS.

Chessel, D. and Dufour, A.B. and Thioulouse, J. (2004) The ade4 package-I- One-table methods. *R News*, 4, 5-10.

Dray, S. & Dufour, A.B. (2007) The ade4 package: implementing the duality diagram for ecologists. *Journal of Statistical Software*, 22(4), 1-20.

Dray, S. & Dufour, A.B. and Chessel, D. (2007) The ade4 package-II: Two-table and K-table methods. *R News*, 7(2), 47-52.

Dray , S., Dufour , A-B. & Thioulouse , J. (2015) Analysis of Ecological Data : Exploratory and Euclidean Methods in Environmental Sciences. R package version 1.7-2. Available at: https:

//CRAN.R-project.org/package=ade4.

Guisande, C., Manjarrés-Hernández, A., Pelayo-Villamil, P., Granado-Lorencio, C., Riveiro, I., Acuña, A., Prieto-Piraquive, E., Janeiro, E., Matías, J.M., Patti, C., Patti, B., Mazzola, S., Jiménez, S., Duque, V. & Salmerón, F. (2010) IPez: An expert system for the taxonomic identification of fishes based on machine learning techniques. *Fisheries Research*, 102, 240-247.

Examples

```
## Not run:

data(Z1)

F45(data=Z1, variable1="M12", variable2="M15", group="Species",
group1="Triportheus angulatus", row=54, LEGEND = c("x='topright'",
"legend=dati", "col=col", "bty = 'n'", "pch=c(16,16)", "text.font=3"))

## End(Not run)
```

F46 *POLAR COORDINATES*

Description

This function calculates the polar coordinates of several variables.

Usage

```
F46(data, variables, group=NULL, cor=TRUE, ellipse=FALSE, convex=FALSE,
SCATTERPLOT=NULL, ResetPAR=TRUE, PAR=NULL, XLAB=NULL, YLAB=NULL, XLIM=NULL,
YLIM=NULL, PCH=NULL, COLOR=NULL, LEGEND=NULL, MTEXT= NULL, TEXT=NULL,
arrows=TRUE, larrow=1, ARROWS=NULL, TEXTa=NULL, file="Polar coordinates.csv",
na="NA", dec=",", row.names=FALSE)
```

Arguments

`data`	Data file.
`variables`	Variables to be selected. If qualitative variables are used as independent variables, they must be put into a countable number of categories, i.e., the names of the categories must be numbers.
`group`	Variable with the groups to be discriminated.
`cor`	If it is TRUE the variables are ordered according to the correlation between them when estimating the polar coordinates. Therefore, the next variable to another variable is the one that has a greater positive correlation.
`ellipse`	If it is TRUE the ellipses with the levels of significance to the 0.5 (inner ellipse) and 0.95 (outer ellipse) of each category of the variable *group* is depicted. These levels of significance can be modified by entering the function scatterplot using the argument *SCATTERPLOT* and modifying the argument *levels=c(0.5,0.95)*.

convex	If it is TRUE the convex hull is depicted for each category.
SCATTERPLOT	It accesses the function scatterplot of the car package, with the graph *biplot*.
ResetPAR	If it is FALSE, the default condition of the function PAR is not placed and maintained those defined by the user in previous graphics.
PAR	It accesses the function PAR that allows to modify many different aspects of the graph.
XLAB	Legend of the X axis.
YLAB	Legend of the Y axis.
XLIM	Vector with the limits of the X axis.
YLIM	Vector with the limits of the Y axis.
PCH	Vector with the symbols, that should be as many as different groups the variable *group* has. If NULL, they are automatically calculated starting with the symbol 15.
COLOR	It allows to modify the colors of the scatterplot. It must be as many as different categories of the variable *group*.
LEGEND	It allows to modify the legend of the scatterplot.
MTEXT	It allows to add text on the margins of the scatterplot.
TEXT	It allows to add text in any area of the inner part of the scatterplot.
arrows	If it is TRUE the arrows are shown in the scatterplot with the polar coordinates. These arrows show the vector of the variables selected when calculating the polar coordinates.
larrow	It modifies the length of the arrows.
ARROWS	It accesses the function Arrows of the package IDPmisc, which performs the arrows.
TEXTa	It allows to modify the labels at the end of the arrows.
file	CSV FILES. Filename with the polar coordinates.
na	CSV FILE. Text that is used in the cells without data.
dec	CSV FILE. It defines if the comma "," is used as decimal separator or the dot ".".
row.names	CSV FILE. Logical value that defines if identifiers are put in rows or a vector with a text for each of the rows.

Details

Polar coordinates

All variables are transformed to a scale ranged between -1 and 1. For each value the X and Y polar coordinates are estimated using the following equations:

$$X = \sum_{i=1}^{n} |z_j| cos(\alpha) \quad Y = \sum_{i=1}^{n} |z_j| sin(\alpha)$$

where *z* is the value of the variable *j* and *n* the number of variables.

Each variable is assigned an angle (α). The increment value of the angle is always $\frac{360}{n*2}$. If for instance the number of variables are 5, the increment angle is 36. Therefore, for the first variable if the value is ≥ 0 the α value is 36 and if the value is < 0 the value is 36+180, for the second variable if the value is ≥ 0 the α value is 36+36 and if the value is < 0 the value is 36+36+180, etc. Degrees to radians angle conversion is carried out assuming that 1 degree = 0.0174532925 radians.

Therefore, the order of the variables is important because a different alpha value is assigned. If the argument *cor=TRUE*, the order is established calculating the correlation matrix of the variables, and ordering them in the way that each variable will be followed by the variable to which is highly correlated. The goal is to favor a larger dispersion of the data in the resulting polar coordinates system.

FUNCTIONS

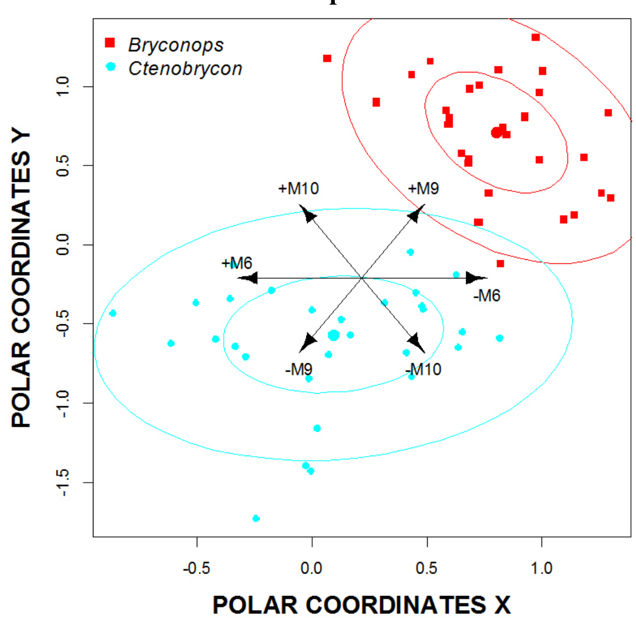
The arrows are depicted with the function Arrows of the package IDPmisc (Locher & Ruckstuhl, 2014). The scatterplot is performed with the function scatterplot of the car package (Fox & Weisberg, 2011; Fox et al., 2014). The convex hull is estimated with the function chull of the package grDevices.

EXAMPLES

For the example, morphometric data of three families of freshwater fishes, as the distance from the origin of the dorsal fin to the origin of the anal fin (M13), the length of the dorsal fin base (M12), body height (M11), etc., are used. For details see Guisande et al. (2010).

Figure shows the plots obtained in an example comparing the genera *Bryconops* and *Ctenobrycon*, with the variables M9, M10 and M6.

Example 1



Value

It is depicted a scatter plot with the polar coordinates, which are also saved in a CSV file.

References

Fox, J. & Weisberg, S. (2011) An R Companion to Applied Regression, Second Edition. Thousand Oaks CA: Sage. http://socialsciences.mcmaster.ca/jfox/Books/Companion/.

Fox, J., Weisberg, S., Adler, D., Bates, D., Baud-Bovy, G., Ellison, S., Firth, D., Friendly, M., Gorjanc, G., Graves, S., Heiberger, R., Laboissiere, R., Monette, G., Murdoch, D., Nilsson, H., Ogle, D., Ripley, B., Venables, W. & Zeileis, A. (2014) Companion to Applied Regression. R package version 2.0-20. Available at: https://CRAN.R-project.org/package=car.

Guisande, C., Manjarrés-Hernández, A., Pelayo-Villamil, P., Granado-Lorencio, C., Riveiro, I., Acuña, A., Prieto-Piraquive, E., Janeiro, E., Matías, J.M., Patti, C., Patti, B., Mazzola, S., Jiménez, S., Duque, V. & Salmerón, F. (2010) IPez: An expert system for the taxonomic identification of fishes based on machine learning techniques. *Fisheries Research*, 102, 240-247.

Locher, R. & Ruckstuhl, A. (2014) Utilities of Institute of Data Analyses and Process Design. R package version 1.1.17. Available at: https://CRAN.R-project.org/package=IDPmisc.

Examples

```
## Not run:

data(Z1)

Z1<-subset(Z1,(Genus == "Bryconops") | (Genus == "Ctenobrycon"))

F46(data=Z1, variables=c("M9","M10","M6"), group="Genus", ellipse=TRUE,
LEGEND=c("x='topleft'", "legend=unique(datosF[,'Group'])",
"col=color1", "pch=pcht", "bty='n'", "cex=1.2", "text.font=3") )

## End(Not run)
```

F47 *BARPLOTS FOR ONE VARIABLE*

Description

It performs a barplot for one variable, with or without error bars.

Usage

```
F47(data, varY, varX, method="mean", dev=NULL, horiz=FALSE, BARPLOT=NULL, ResetPAR=TRUE,
PAR=NULL, order=NULL, OrderCat=NULL, LabelCat=NULL, XLAB=NULL, YLAB=NULL,
XLIM=NULL, YLIM=NULL, COLOR=NULL, LEGEND=NULL , AXIS=NULL, MTEXT= NULL, TEXT=NULL)
```

Arguments

data	Data file.
varY	Dependent variable.
varX	Qualitative independent variable with the categories.

method	The average of each category of the independent variable *varX* is estimated with the "mean" or the "median".
dev	If it is not NULL, the error bars may be estimated using the standard deviation ("sd") or the standard error ("se").
horiz	If it is FALSE, the bars are drawn vertically with the first bar to the left. If it is TRUE, the bars are drawn horizontally with the first at the bottom.
BARPLOT	It accesses the function barplot that allows to modify the barplot.
ResetPAR	If it is FALSE, the default condition of the function PAR is not placed and maintained those defined by the user in previous graphics.
PAR	It accesses the function PAR that allows to modify many different aspects of the graph.
order	If it is NULL the categories are ordered as found in the variable *FactorX*, if it is "increasing" are ordered from lesser to greater median or mean according to the method selected in the argument *method*, if it is "decreasing" are ordered from greater to lesser median or mean, if it is "alphaAZ" are ordered from A to Z and if it is "alphaZA" from Z to A.
OrderCat	It allows to specify a vector with the order in which the categories are shown. If this argument is specified, the argument *order* is not taken into account.
LabelCat	It allows to specify a vector with the names of the categories.
XLAB	Legend of the X axis.
YLAB	Legend of the Y axis.
XLIM	Vector with the limits of the X axis.
YLIM	Vector with the limits of the Y axis.
COLOR	Color of bars. It must be a single color or as many as different categories of the variable *varX*.
LEGEND	It allows to add a legend to the graph.
AXIS	It allows to add axes to the graph.
MTEXT	It allows to add text on the margins of the graph.
TEXT	It allows to add text in any area of the inner part of the graph.

Details

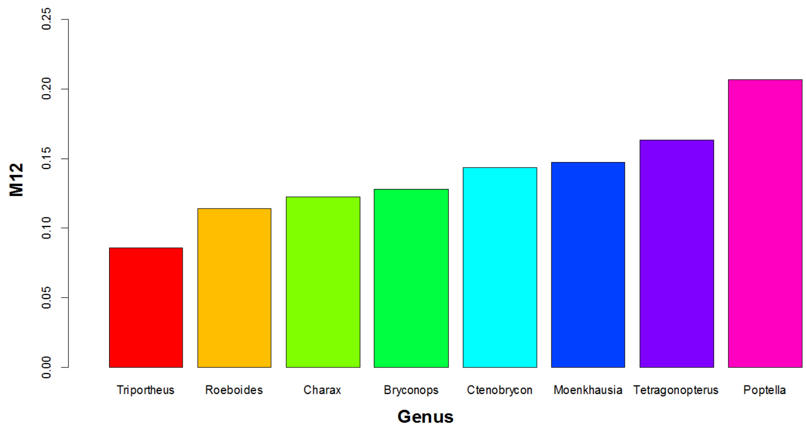
FUNCTIONS

The plot is performed with the functions barplot and arrows of base graphics package. For further details see Guisande & Vammonde (2012).

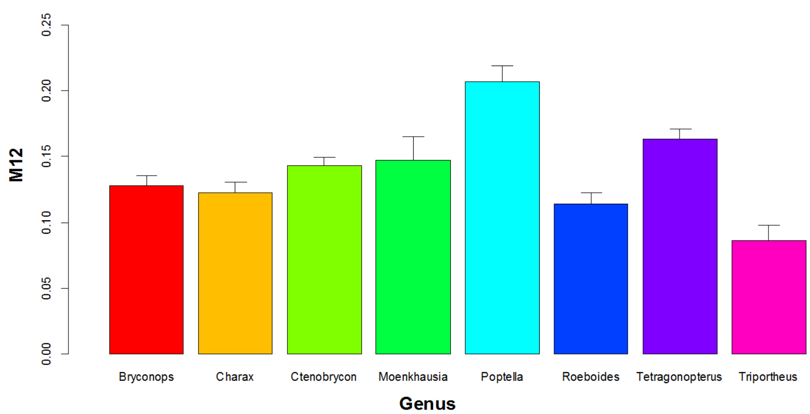
EXAMPLES

For the example, morphometric data of three families of freshwater fishes are used. For details see Guisande et al. (2010).

Example 1 The mean value without standard deviations for the M12 is shown for all genera.



Example 2 The mean value for the M12 is shown for all genera and the standard deviations with the argument *dev="sd"*.



Value

A barplot for one variable, with or without error bars, is obtained.

References

Guisande, C., Manjarrés-Hernández, A., Pelayo-Villamil, P., Granado-Lorencio, C., Riveiro, I., Acuña, A., Prieto-Piraquive, E., Janeiro, E., Matías, J.M., Patti, C., Patti, B., Mazzola, S., Jiménez, S., Duque, V. & Salmerón, F. (2010) IPez: An expert system for the taxonomic identification of fishes based on machine learning techniques. *Fisheries Research*, 102, 240-247.

Guisande, C. & Vaamonde, A. (2012) *Gráficos estadísticos y mapas con R*. Ediciones Díaz de Santos, Madrid, 367 pp.

Examples

```
## Not run:
```

```
#Example 1

data(Z1)

F47(data=Z1, varY="M12", varX="Genus", order="increasing")

#Example 2

F47(data=Z1, varY="M12", varX="Genus", dev="sd")

## End(Not run)
```

F48 *BARPLOTS FOR SEVERAL VARIABLES*

Description

It performs a barplot for several variables, with or without error bars.

Usage

```
F48(data, varY, varX, method="mean", dev=NULL, horiz=FALSE, beside=TRUE,
BARPLOT=NULL, ResetPAR=TRUE, PAR=NULL,order=NULL, OrderCat=NULL,
LabelCat=NULL, XLAB=NULL, YLAB=NULL, XLIM=NULL, YLIM=NULL, COLOR=NULL,
LEGEND=NULL, AXIS=NULL, MTEXT= NULL, TEXT=NULL)
```

Arguments

`data`	Data file.
`varY`	Dependent variable.
`varX`	Qualitative independent variable with the categories.
`method`	The average of each category of the independent variable *varX* is estimated with the "mean" or the "median".
`dev`	If it is not NULL, the error bars may be estimated using the standard deviation ("sd") or the standard error ("se").
`horiz`	If it is FALSE, the bars are drawn vertically with the first bar to the left. If it is TRUE, the bars are drawn horizontally with the first at the bottom.
`beside`	If it is FALSE, the columns of height are portrayed as stacked bars, and if TRUE the columns are portrayed as juxtaposed bars.
`BARPLOT`	It accesses the function barplot that allows to modify the barplot.
`ResetPAR`	If it is FALSE, the default condition of the function PAR is not placed and maintained those defined by the user in previous graphics.
`PAR`	It accesses the function PAR that allows to modify many different aspects of the graph.

`order`	If it is NULL the categories are ordered as found in the variable *FactorX*, if it is "increasing" are ordered from lesser to greater median or mean according to the method selected in the argument *method*, if it is "decreasing" are ordered from greater to lesser median or mean, if it is "alhaAZ" are ordered from A to Z and if it is "alphaZA" from Z to A.
`OrderCat`	It allows to specify a vector with the order in which the categories are shown. If this argument is specified, the argument *order* is not taken into account.
`LabelCat`	It allows to specify a vector with the names of the categories.
`XLAB`	Legend of the X axis.
`YLAB`	Legend of the Y axis.
`XLIM`	Vector with the limits of the X axis.
`YLIM`	Vector with the limits of the Y axis.
`COLOR`	Color of bars. It must be a single color or as many as different variables of *varY*.
`LEGEND`	It allows to add a legend to the graph.
`AXIS`	It allows to add axes to the graph.
`MTEXT`	It allows to add text on the margins of the graph.
`TEXT`	It allows to add text in any area of the inner part of the graph.

Details

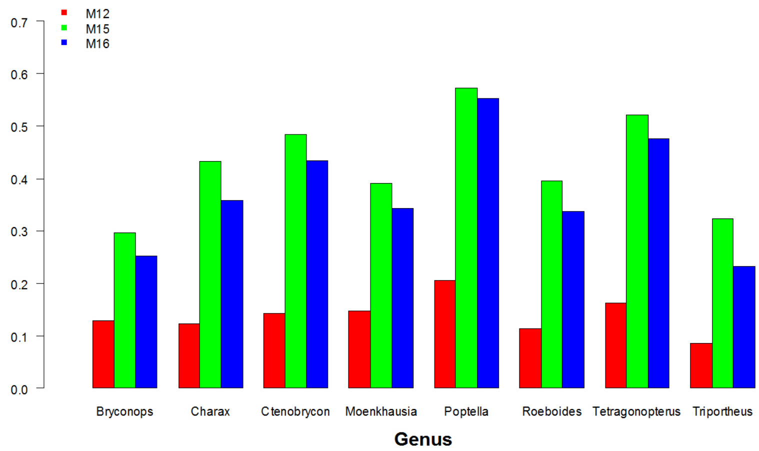
FUNCTIONS

The plot is performed with the functions barplot and arrows of base graphics package. For further details see Guisande & Vammonde (2012).

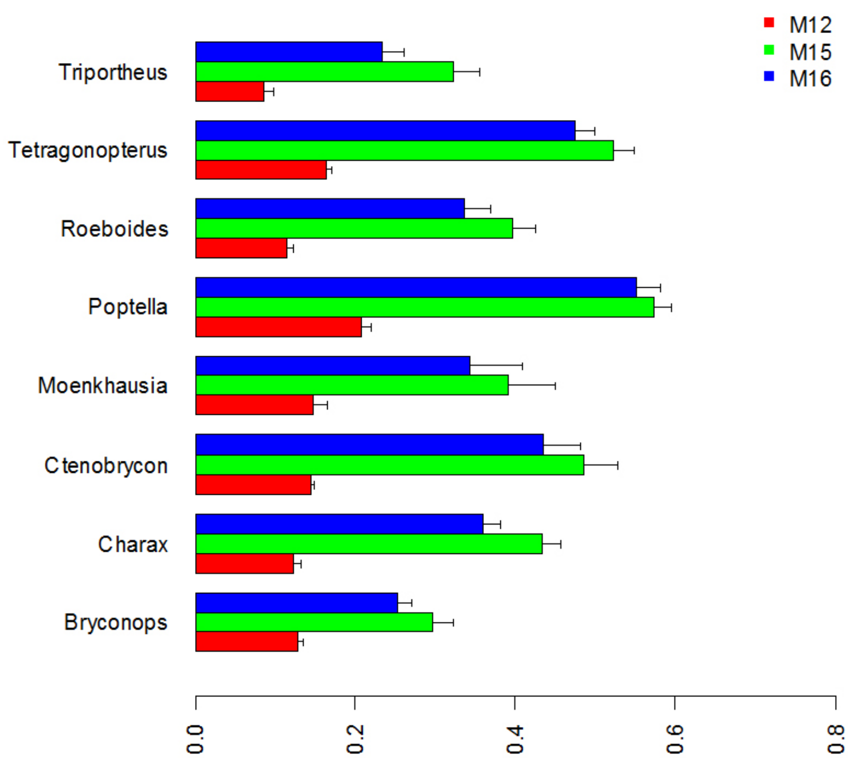
EXAMPLES

For the example, morphometric data of three families of freshwater fishes, as the distance from the origin of the dorsal fin to the origin of the anal fin (M13), the length of the dorsal fin base (M12), body height (M11), etc., are used. For details see Guisande et al. (2010).

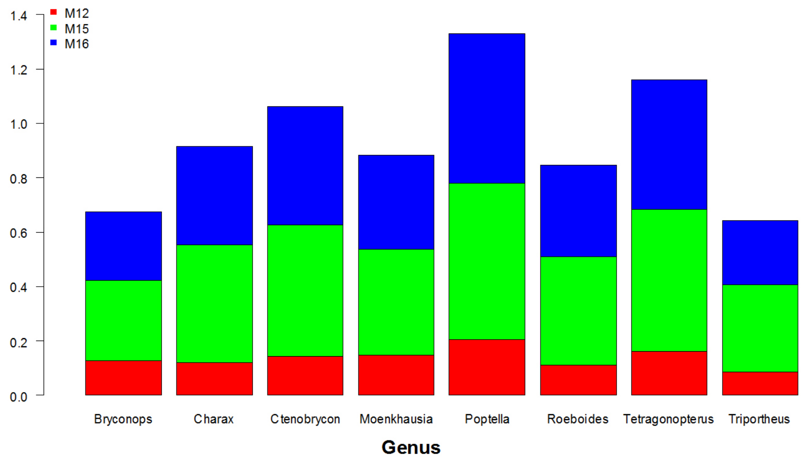
Example 1 The mean value for the M12, M15 and M16 is shown for all genera in alphabetical order with the argument *order="alphaAZ"* and without standard deviations.



Example 2 The mean value for the M12, M15 and M16 is shown for all genera and the standard deviations with the argument *dev="sd"*. The bars are horizontal with the argument *hori=TRUE*.



Example 3 The columns of height are portrayed as stacked with the argument *beside=FALSE*.



Value

A barplot for several variables, with or without error bars, is obtained.

References

Guisande, C., Manjarrés-Hernández, A., Pelayo-Villamil, P., Granado-Lorencio, C., Riveiro, I., Acuña, A., Prieto-Piraquive, E., Janeiro, E., Matías, J.M., Patti, C., Patti, B., Mazzola, S., Jiménez, S., Duque, V. & Salmerón, F. (2010) IPez: An expert system for the taxonomic identification of fishes based on machine learning techniques. *Fisheries Research*, 102, 240-247.

Guisande, C. & Vaamonde, A. (2012) *Gráficos estadísticos y mapas con R*. Ediciones Díaz de Santos, Madrid, 367 pp.

Examples

```
## Not run:

#Example 1

data(Z1)

F48(data=Z1, varY=c("M12","M15","M16"), varX="Genus", order="alphaAZ")

#Example 2

data(Z1)

F48(data=Z1, varY=c("M12","M15","M16"), varX="Genus", dev="sd", horiz=TRUE)

#Example 3

data(Z1)

F48(data=Z1, varY=c("M12","M15","M16"), varX="Genus", beside=FALSE)
```

```
## End(Not run)
```

F49 *BARPLOTS WITH CYLINDRICAL BARS FOR ONE VARIABLE*

Description

It performs a barplot for one variable, with or without error bars.

Usage

```
F49(data, varY, varX, method="mean", dev=NULL, BARPLOT=NULL, ResetPAR=TRUE,
PAR=NULL, order=NULL, OrderCat=NULL, LabelCat=NULL, XLAB=NULL, YLAB=NULL,
XLIM=NULL, YLIM=NULL, COLOR="green", LEGEND=NULL , AXIS=NULL, MTEXT= NULL, TEXT=NULL)
```

Arguments

`data`	Data file.
`varY`	Dependent variable.
`varX`	Qualitative independent variable with the categories.
`method`	The average of each category of the independent variable *varX* is estimated with the "mean" or the "median".
`dev`	If it is not NULL, the error bars may be estimated using the standard deviation ("sd") or the standard error ("se").
`BARPLOT`	It accesses the function barp that allows to modify the barplot.
`ResetPAR`	If it is FALSE, the default condition of the function PAR is not placed and maintained those defined by the user in previous graphics.
`PAR`	It accesses the function PAR that allows to modify many different aspects of the graph.
`order`	If it is NULL the categories are ordered as found in the variable *FactorX*, if it is "increasing" are ordered from lesser to greater median or mean according to the method selected in the argument *method*, if it is "decreasing" are ordered from greater to lesser median or mean, if it is "alhaAZ" are ordered from A to Z and if it is "alphaZA" from Z to A.
`OrderCat`	It allows to specify a vector with the order in which the categories are shown. If this argument is specified, the argument *order* is not taken into account.
`LabelCat`	It allows to specify a vector with the names of the categories.
`XLAB`	Legend of the X axis.
`YLAB`	Legend of the Y axis.
`XLIM`	Vector with the limits of the X axis.
`YLIM`	Vector with the limits of the Y axis.
`COLOR`	Color of bars. It must be a single color or as many as different categories of the variable *varX*.

`LEGEND`	It allows to add a legend to the graph.
`AXIS`	It allows to add axes to the graph.
`MTEXT`	It allows to add text on the margins of the graph.
`TEXT`	It allows to add text in any area of the inner part of the graph.

Details

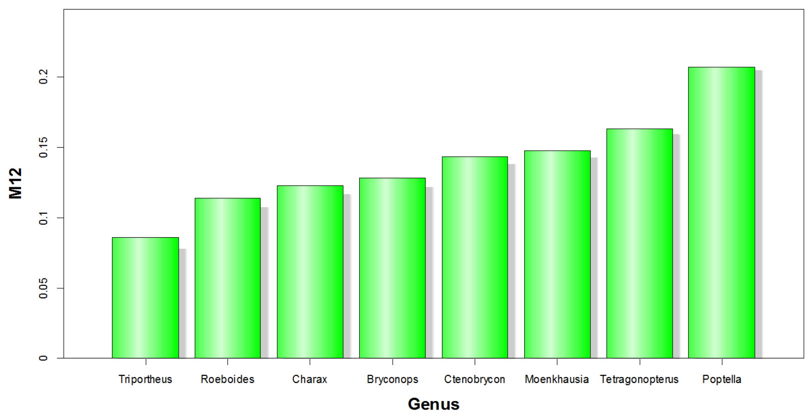
FUNCTIONS

The plot is performed with the functions barp of the package plotrix (Lemon et al., 2015) and arrows of base graphics package. For further details see Guisande & Vammonde (2012).

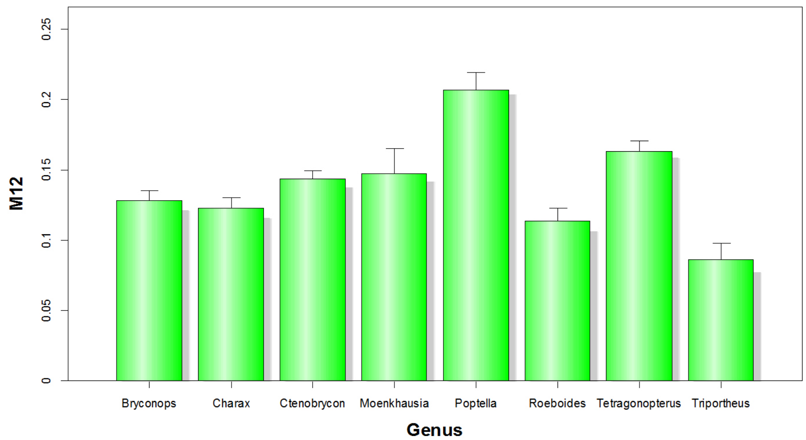
EXAMPLES

For the example, morphometric data of three families of freshwater fishes are used. For details see Guisande et al. (2010).

Example 1 The mean value without standard deviations for the M12 is shown for all genera.



Example 2 The mean value for the M12 is shown for all genera and the standard deviations with the argument *dev="sd"*.



Value

A barplot for one variable, with or without error bars, is obtained.

References

Guisande, C., Manjarrés-Hernández, A., Pelayo-Villamil, P., Granado-Lorencio, C., Riveiro, I., Acuña, A., Prieto-Piraquive, E., Janeiro, E., Matías, J.M., Patti, C., Patti, B., Mazzola, S., Jiménez, S., Duque, V. & Salmerón, F. (2010) IPez: An expert system for the taxonomic identification of fishes based on machine learning techniques. *Fisheries Research*, 102, 240-247.

Guisande, C. & Vaamonde, A. (2012) *Gráficos estadísticos y mapas con R*. Ediciones Díaz de Santos, Madrid, 367 pp.

Lemon, J., Bolker, B., Oom, S., Klein, E., Rowlingson, B., Wickham, H., Tyagi, A., Eterradossi, O., Grothendieck, G., Toews, M., Kane, J., Turner, R., Witthoft, C., Stander, J., Petzoldt, T., Duursma, R., Biancotto, E., Levy, O., Dutang, C., Solymos, P., Engelmann, R., Hecker, M., Steinbeck, F., Borchers, H., Singmann, H., Toal, T. & Ogle, D. (2015) Various plotting functions. R package version 3.5-11. Available at: https://CRAN.R-project.org/package=plotrix.

Examples

```
## Not run:

#Example 1

data(Z1)

F49(data=Z1, varY="M12", varX="Genus",  order="increasing")

#Example 2

F49(data=Z1, varY="M12", varX="Genus",  dev="sd")

## End(Not run)
```

F50 — *BARPLOTS WITH CYLINDRICAL BARS FOR SEVERAL VARIABLES*

Description

It performs a barplot for several variables, with or without error bars.

Usage

```
F50(data, varY, varX, method="mean", dev=NULL, BARPLOT=NULL, ResetPAR=TRUE,
PAR=NULL,order=NULL, OrderCat=NULL, LabelCat=NULL, XLAB=NULL, YLAB=NULL,
XLIM=NULL, YLIM=NULL, COLOR=NULL, LEGEND=NULL, AXIS=NULL, MTEXT= NULL, TEXT=NULL)
```

Arguments

data	Data file.
varY	Dependent variable.
varX	Qualitative independent variable with the categories.
method	The average of each category of the independent variable *varX* is estimated with the "mean" or the "median".
dev	If it is not NULL, the error bars may be estimated using the standard deviation ("sd") or the standard error ("se").
BARPLOT	It accesses the function barp that allows to modify the barplot.
ResetPAR	If it is FALSE, the default condition of the function PAR is not placed and maintained those defined by the user in previous graphics.
PAR	It accesses the function PAR that allows to modify many different aspects of the graph.
order	If it is NULL the categories are ordered as found in the variable *FactorX*, if it is "increasing" are ordered from lesser to greater median or mean according to the method selected in the argument *method*, if it is "decreasing" are ordered from greater to lesser median or mean, if it is "alhaAZ" are ordered from A to Z and if it is "alphaZA" from Z to A.
OrderCat	It allows to specify a vector with the order in which the categories are shown. If this argument is specified, the argument *order* is not taken into account.
LabelCat	It allows to specify a vector with the names of the categories.
XLAB	Legend of the X axis.
YLAB	Legend of the Y axis.
XLIM	Vector with the limits of the X axis.
YLIM	Vector with the limits of the Y axis.
COLOR	Color of bars. It must be a single color or as many as different variables of *varY*.
LEGEND	It allows to add a legend to the graph.
AXIS	It allows to add axes to the graph.
MTEXT	It allows to add text on the margins of the graph.
TEXT	It allows to add text in any area of the inner part of the graph.

Details

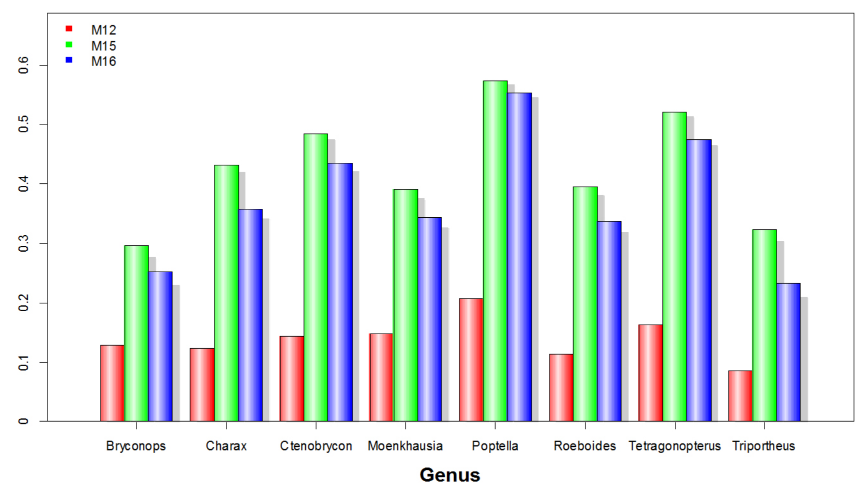
FUNCTIONS

The plot is performed with the functions barp of the package plotrix (Lemon et al., 2015) and arrows of base graphics package. For further details see Guisande & Vammonde (2012).

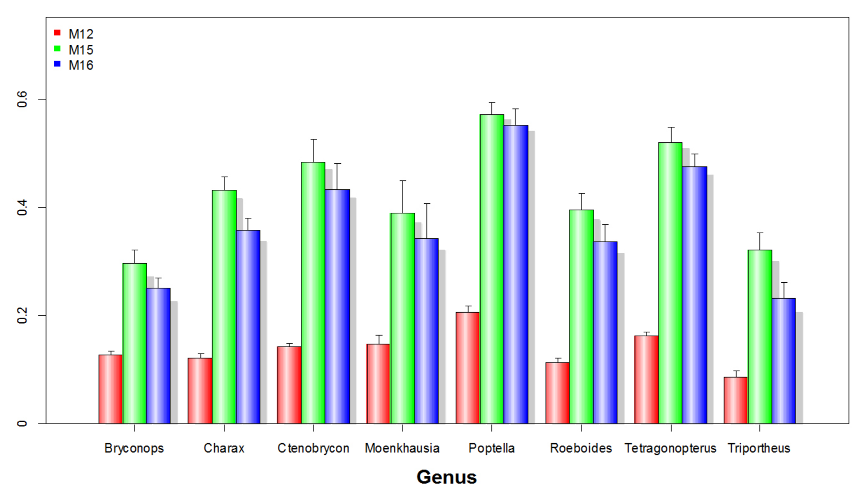
EXAMPLES

For the example, morphometric data of three families of freshwater fishes are used. For details see Guisande et al. (2010).

Example 1 The mean value for the M12, M15 and M16 is shown for all genera in alphabetical order with the argument *order="alphaAZ"* and without standard deviations.



Example 2 The mean value for the M12, M15 and M16 is shown for all genera and the standard deviations with the argument *dev="sd"*.



Value

A barplot for several variables, with or without error bars, is obtained.

References

Guisande, C., Manjarrés-Hernández, A., Pelayo-Villamil, P., Granado-Lorencio, C., Riveiro, I., Acuña, A., Prieto-Piraquive, E., Janeiro, E., Matías, J.M., Patti, C., Patti, B., Mazzola, S., Jiménez, S., Duque, V. & Salmerón, F. (2010) IPez: An expert system for the taxonomic identification of fishes based on machine learning techniques. *Fisheries Research*, 102, 240-247.

Guisande, C. & Vaamonde, A. (2012) *Gráficos estadísticos y mapas con R*. Ediciones Díaz de Santos, Madrid, 367 pp.

Examples

```
## Not run:

data(Z1)

F50(data=Z1, varY=c("M12","M15","M16"), varX="Genus",  order="alphaAZ")

#Example 2

data(Z1)

F50(data=Z1, varY=c("M12","M15","M16"), varX="Genus", dev="sd")

## End(Not run)
```

F51 *BIPLOTS*

Description

It performs biplots with one or two matrices.

Usage

```
F51(data, varY.1, varX.1, cat.1, varY.2=NULL, varX.2=NULL, cat.2=NULL,
labels=NULL, scale=TRUE, ellipse=FALSE, convex=FALSE, SCATTERPLOT=NULL,
LABEL=NULL, ResetPAR=TRUE, PAR=NULL, XLAB=NULL, YLAB=NULL, XLIM1=NULL,
YLIM1=NULL, PCH=NULL, COLOR=NULL, LEGEND=NULL, MTEXT= NULL, TEXT1=NULL,
ARROWS=NULL, XLIM2=NULL, YLIM2=NULL, TEXT2=NULL)
```

Arguments

`data`	Data file.
`varY.1`	Variable Y of matrix 1.
`varX.1`	Variable X of matrix 1.
`cat.1`	Variable of matrix 1 with the groups to be discriminated.
`varY.2`	Variable Y of matrix 2, which is depicted with arrows.
`varX.2`	Variable X of matrix 2, which is depicted with arrows
`cat.2`	Variable of matrix 2 with the text at the end of the arrows.
`labels`	Variable of matrix 1 with the text labels.
`scale`	If it is TRUE the scale of matrix 2, which is depicted with arrows, it is adjusted to the scale of matrix 1.
`ellipse`	If it is TRUE the ellipses with the levels of significance to the 0.5 (inner ellipse) and 0.95 (outer ellipse) of each category of the variable *cat.1* is depicted. These levels of significance can be modified by entering the function scatterplot using the argument *SCATTERPLOT* and modifying the argument *levels=c(0.5,0.95)*.
`convex`	If it is TRUE the convex hull is depicted for each category.
`SCATTERPLOT`	It accesses the function scatterplot of the car package, with the graph *biplot*.
`LABEL`	It allows to specify the characteristics of the text labels of the argument *labels*, with the function text.
`ResetPAR`	If it is FALSE, the default condition of the function PAR is not placed and maintained those defined by the user in previous graphics.
`PAR`	It accesses the function PAR that allows to modify many different aspects of the graph.
`XLAB`	Legend of the X axis.
`YLAB`	Legend of the Y axis.
`XLIM1`	Vector with the limits of the X axis in the matrix 1.
`YLIM1`	Vector with the limits of the Y axis in the matrix 1.
`PCH`	Vector with the symbols, that should be as many as different groups the variable *cat.1* has. If NULL, they are automatically calculated starting with the symbol 15.
`COLOR`	It allows to modify the colors of the scatterplot. It must be as many as different categories of the variable *cat.1*.
`LEGEND`	It allows to modify the legend of the scatterplot.
`MTEXT`	It allows to add text on the margins of the scatterplot.
`TEXT1`	It allows to add text in any area of the inner part of the scatterplot.
`ARROWS`	It accesses the function Arrows of the package IDPmisc, which performs the arrows.
`XLIM2`	Vector with the limits of the X axis in the matrix 2.
`YLIM2`	Vector with the limits of the Y axis in the matrix 2.
`TEXT2`	It allows to modify the labels at the end of the arrows.

Details

FUNCTIONS

The arrows are depicted with the function Arrows of the package IDPmisc (Locher & Ruckstuhl, 2014).

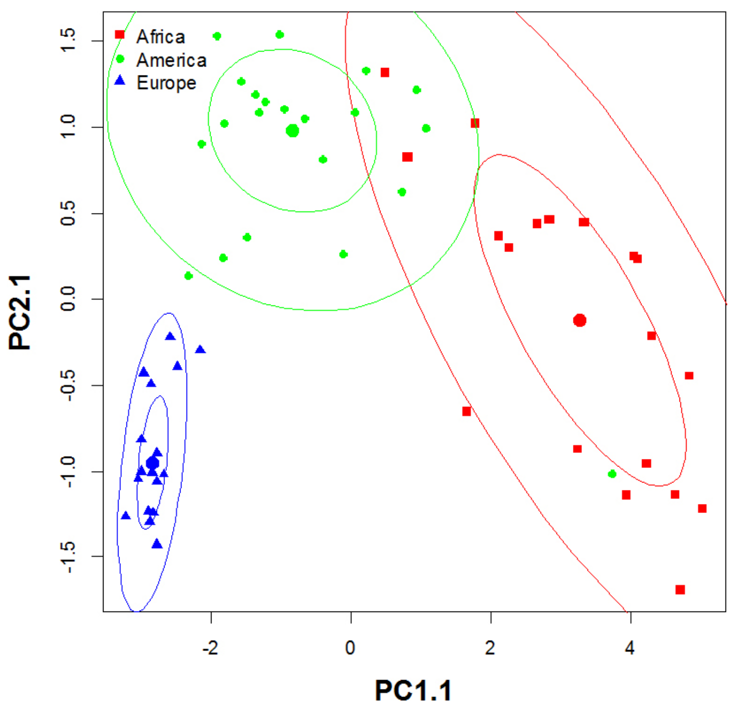
The scatterplot is performed with the function scatterplot of the car package (Fox & Weisberg, 2011; Fox et al., 2014).

The convex hull is estimated with the function chull of the package grDevices.

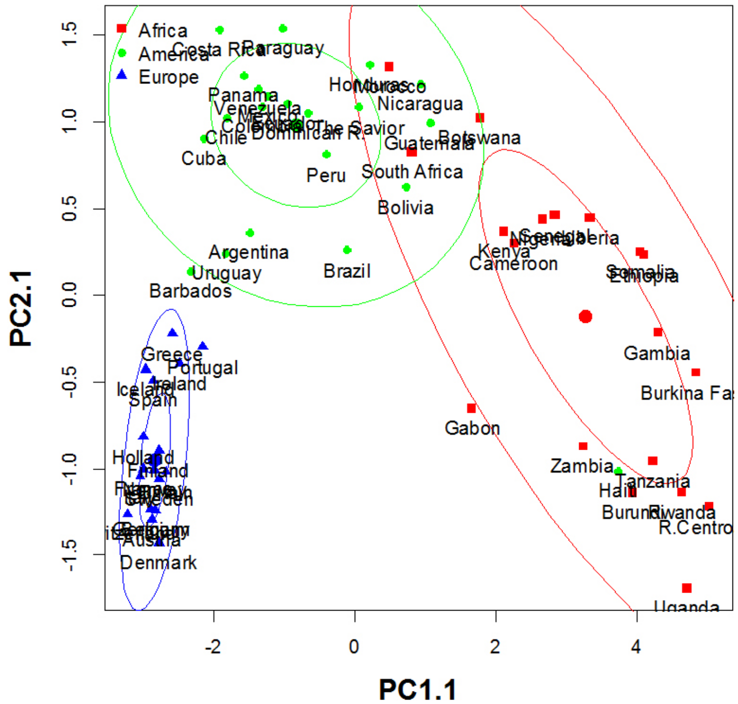
EXAMPLES

The dataset is the output of a Principal Component Analysis (PCA) of a study carried out with demographic parameters of 57 countries in Europe, Africa and America. The variables used were male and female life expectancy at birth (in years of life), the mortality rates, infant mortality, birth, and fertility, the gross domestic product per capita (in thousands of dollars per year) and the literacy rate for men and women (in percentage) in the year 2000. The data were obtained from The World Bank `https://www.worldbank.org/en/home`.

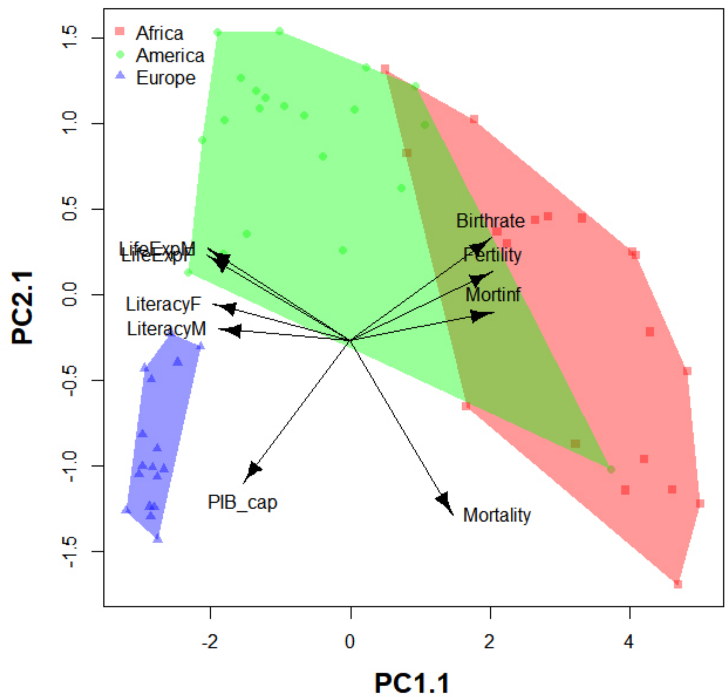
Example 1 Biplot with the scores of the axes 1 and 2 of the PCA, where the categories are the continents and the ellipses are shown with the argument *ellipse=TRUE*.



Example 2 As the example 1 but the scores are labeled with the countries using the argument *labels="Country"*.



Example 3 As the example 1 but a second matrix is added with the position of the variables in the PCA and the convex hull is depicted for each category with the argument *convex=TRUE*.



Value

It is depicted a biplot with one or two matrices.

References

Fox, J. & Weisberg, S. (2011) An R Companion to Applied Regression, Second Edition. Thousand Oaks CA: Sage. `http://socialsciences.mcmaster.ca/jfox/Books/Companion/`.

Fox, J., Weisberg, S., Adler, D., Bates, D., Baud-Bovy, G., Ellison, S., Firth, D., Friendly, M., Gorjanc, G., Graves, S., Heiberger, R., Laboissiere, R., Monette, G., Murdoch, D., Nilsson, H., Ogle, D., Ripley, B., Venables, W. & Zeileis, A. (2014) Companion to Applied Regression. R package version 2.0-20. Available at: `https://CRAN.R-project.org/package=car`.

Guisande, C., Manjarrés-Hernández, A., Pelayo-Villamil, P., Granado-Lorencio, C., Riveiro, I., Acuña, A., Prieto-Piraquive, E., Janeiro, E., Matías, J.M., Patti, C., Patti, B., Mazzola, S., Jiménez, S., Duque, V. & Salmerón, F. (2010) IPez: An expert system for the taxonomic identification of fishes based on machine learning techniques. *Fisheries Research*, 102, 240-247.

Locher, R. & Ruckstuhl, A. (2014) Utilities of Institute of Data Analyses and Process Design. R package version 1.1.17. Available at: `https://CRAN.R-project.org/package=IDPmisc`.

Examples

```
## Not run:

#Example 1

data(Z18)
```

```
F51(data=Z18, varY.1="PC2.1", varX.1="PC1.1", cat.1="Continent", ellipse=TRUE)

#Example 2

data(Z18)

F51(data=Z18, varY.1="PC2.1", varX.1="PC1.1", cat.1="Continent", ellipse=TRUE,
labels="Country")

#Example 3

data(Z18)

F51(data=Z18, varY.1="PC2.1", varX.1="PC1.1", cat.1="Continent", convex=TRUE,
varY.2="PC2.2", varX.2="PC1.2", cat.2="Variables")

## End(Not run)
```

F52 *POPULATION PYRAMID PLOT*

Description

It performs a population pyramid plot for many variables.

Usage

```
F52(data, lbars, rbars, labels, toplabels=c("Males","Age","Females"),
showvalues=0, PYRAMIDPLOT=NULL, ResetPAR=TRUE, PAR=NULL, XLIM=NULL,
COLOR=NULL, LEGEND=NULL, MTEXT= NULL, TEXT=NULL)
```

Arguments

`data`	Data file.
`lbars`	Variable or variables to be located in the right bars.
`rbars`	Variable or variables to be located in the left bars. There must be the same number than those of *lbars*.
`labels`	Variable with the labels for the categories represented by each pair of bars.
`toplabels`	The names represented on the left and right sides of the plot and a heading for the labels in the center.
`showvalues`	If it is 0 the values are not represented, if it is 1 the values of the first set *lbars[1]* and *lbars[1]* are shown, if it is 2 the values of the second set *lbars[2]* and *lbars[2]* are shown, etc.
`PYRAMIDPLOT`	It accesses the function pyramid.plot that allows to modify the population plot.
`ResetPAR`	If it is FALSE, the default condition of the function PAR is not placed and maintained those defined by the user in previous graphics.

`PAR`	It accesses the function PAR that allows to modify many different aspects of the graph.
`XLIM`	Vector with two values, with the maximum values for left bars and right bars.
`COLOR`	Color of bars. It must be as many as different variables of *lbars* and *rbars*. As the color has transparency, the plot must be copy as bitmap and not metafile.
`LEGEND`	It allows to modify the legend to the graph.
`MTEXT`	It allows to add text on the margins of the graph.
`TEXT`	It allows to add text in any area of the inner part of the graph.

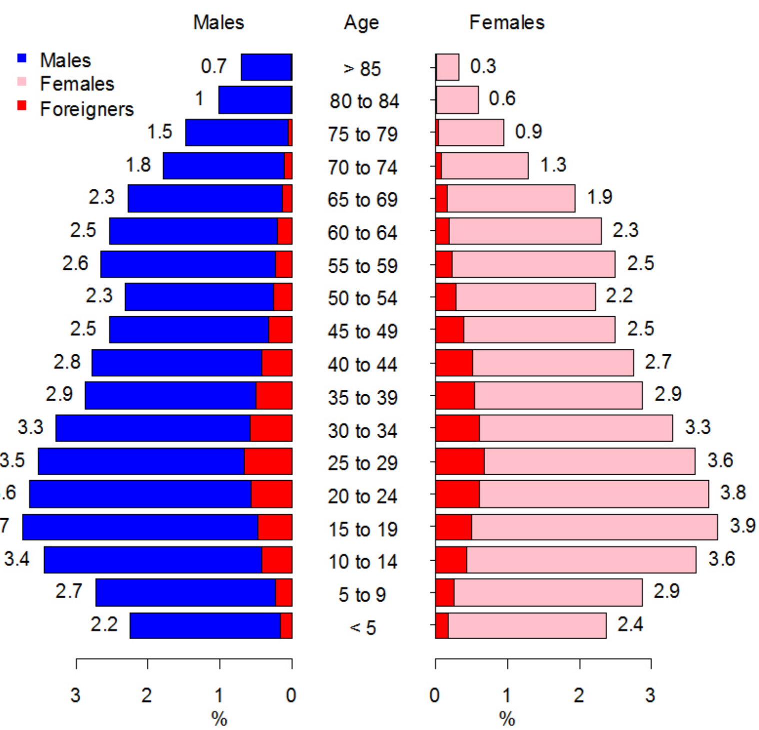
Details

FUNCTIONS

The plot is performed with the functions pyramid.plot of the package plotrix (Lemon et al., 2015). For further details see Guisande & Vammonde (2012).

EXAMPLES

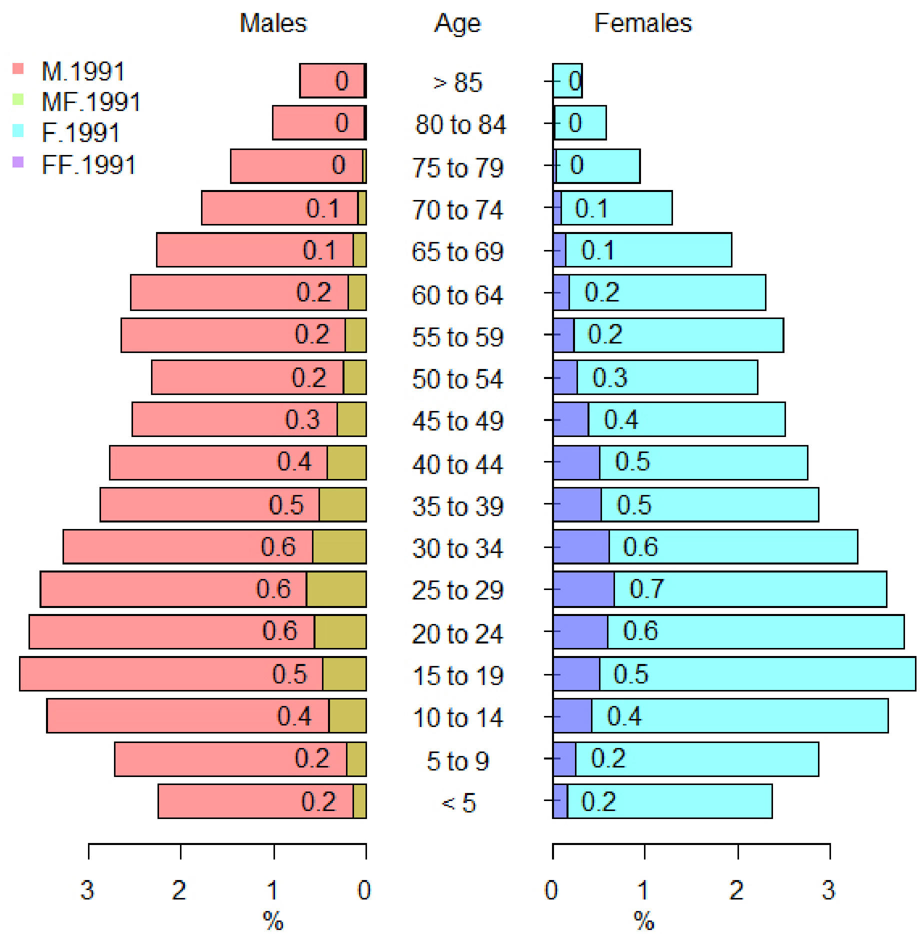
Human population density by sex and age group in Spain for the years 1900 and 1991. Data were obtained from the Spanish Statistical Office `http://www.ine.es`. An array (matrix) with 7 columns: Age group, males in 1900, females in 1900, males in 1991, females in 1991, foreign males in 1991 and foreign females in 1991.



Example 1 It is depicted the males, females and foreigners in 1991. The colors are modified with the argument *COLOR* and the legend with the argument *LEGEND*. With the argument *showvalues=1*

is indicated to show the values of the first set of data, in this case M.1991 and F.1991, so the first variable for both *lbars* and *rbars*.

Example 2 The default options are used with the exception that, with the argument *showvalues=2*, it is depicted the values of the second set of data, in this case MF.1991 and FF.1991, so the second variable for both *lbars* and *rbars*.



Value

A population pyramid plot is obtained.

References

Guisande, C. & Vaamonde, A. (2012) *Gráficos estadísticos y mapas con R*. Ediciones Díaz de Santos, Madrid, 367 pp.

Lemon, J., Bolker, B., Oom, S., Klein, E., Rowlingson, B.,Wickham, H., Tyagi, A., Eterradossi, O., Grothendieck, G., Toews, M., Kane, J., Turner, R., Witthoft, C., Stander, J., Petzoldt, T., Duursma, R., Biancotto, E., Levy, O., Dutang, C., Solymos, P., Engelmann, R., Hecker, M., Steinbeck, F., Borchers, H., Singmann, H., Toal, T. & Ogle, D. (2015) Various plotting functions. R package version 3.5-11. Available at: https://CRAN.R-project.org/package=plotrix.

Examples

```
## Not run:

#Expample 1

data(Z7)

F52(data=Z7, lbars=c("M.1991","MF.1991"), rbars=c("F.1991","FF.1991"),
labels="Age", showvalues=1, COLOR=c("blue","red","pink","red"),
LEGEND = c("x = 'topleft'","legend=c('Males', 'Females', 'Foreigners')",
"col=c('blue','pink','red')" , "pch = 15" , "bty = 'n'"))

#Expample 2

data(Z7)

F52(data=Z7, lbars=c("M.1991","MF.1991"), rbars=c("F.1991", "FF.1991"),
labels="Age", showvalues=2)

## End(Not run)
```

F53 *BUBBLE CHART*

Description

It performs a bubble chart in which a variable defines the size of the bubble and other variable the color gradient of the bubbles.

Usage

```
F53(data, varY, varX, varSize=NULL, varColor=NULL, palette= "heat.colors",
size=c(1,5), legSpos="topleft", orientation="vertical", digitsS=1, digitsC=1,
ncolor=10, transparency=1, ResetPAR=TRUE, PAR=NULL, PLOT=NULL, POINTS=NULL,
COLEGEND=NULL, XLAB=NULL, YLAB=NULL, XLIM=NULL, YLIM=NULL, LEGENDS=NULL,
MTEXT= NULL, TEXT=NULL, AXIS=NULL)
```

Arguments

data	Data file.
varY	Variable Y.
varX	Variable X.
varSize	This variable defines the size of the bubble.
varColor	This variable defines the color gradient of the bubbles.

palette	The color gradient may be one of these palettes: "heat.colors", "terrain.colors", "gray.colors", "topo.colors" or "cm.colors".
size	Range of size of the bubbles. Two values: minimum and maximum size.
legSpos	Position of the size legend: "topleft", "topright", "bottomleft" or "bottomright".
orientation	Orientation of the size legend: "vertical" or "horizontal"
digitsS	Number of digits of the bubble size legend.
digitsC	Number of digits of the color legend.
ncolor	Number of breakpoints of the color legend.
transparency	Transparency of the color gradient, from 0 to 1.
ResetPAR	If it is FALSE, the default condition of the function PAR is not placed and maintained those defined by the user in previous graphics.
PAR	It accesses the function PAR that allows to modify many different aspects of the graph.
PLOT	It allows to modify the plot with the function plot.default.
POINTS	It allows to modify the points of the plot with the function points.
COLEGEND	It allows to modify the color legend with the function color.legend.
XLAB	Legend of the X axis.
YLAB	Legend of the Y axis.
XLIM	Vector with the limits of the X axis.
YLIM	Vector with the limits of the Y axis.
LEGENDS	It allows to modify the legend of the bubble size.
MTEXT	It allows to add text on the margins of the graph.
TEXT	It allows to add text in any area of the inner part of the graph.
AXIS	It allows to add axes to the graph.

Details

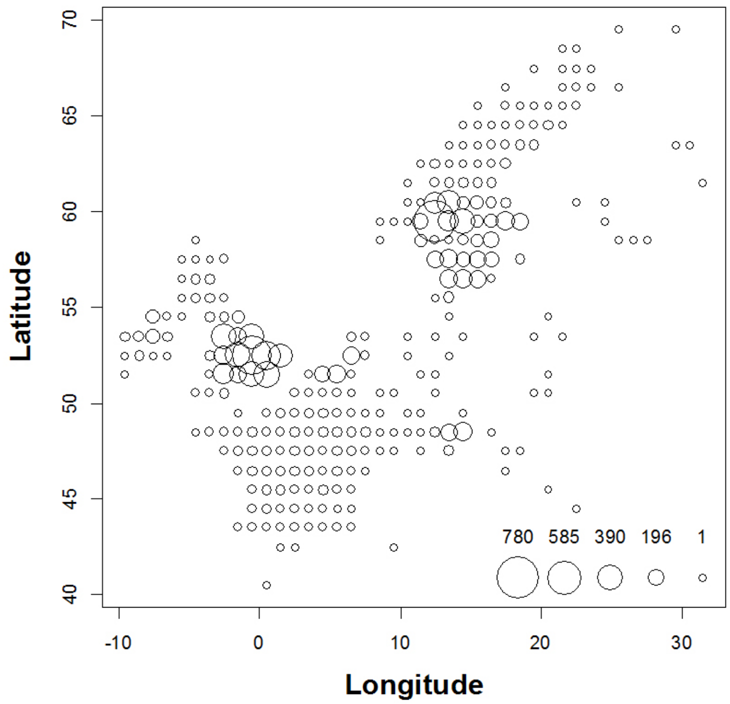
FUNCTIONS

The plot is performed with the function plot.default of base graphics package. The color legend is performed with the function color.legend of the package plotrix (Lemon et al., 2015).

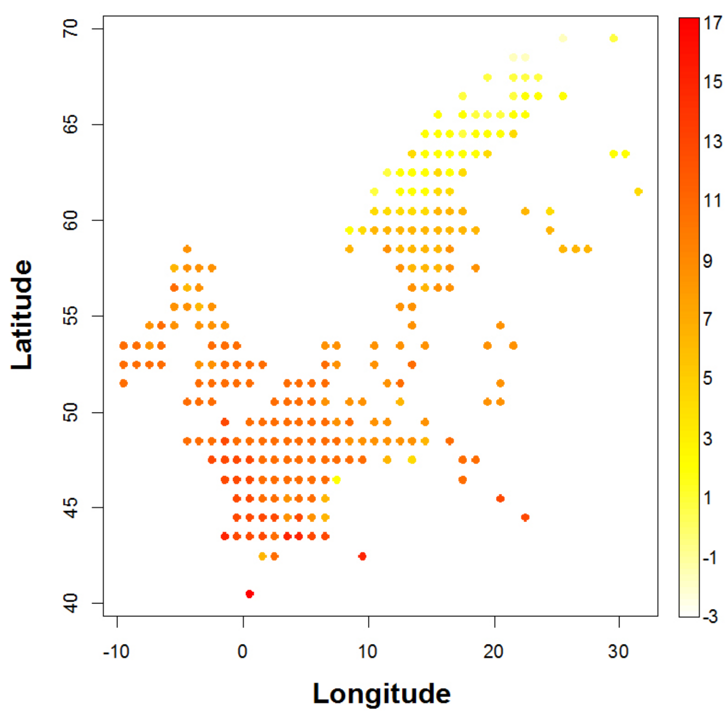
EXAMPLES

The examples use the records of the freshwater fish species *Perca fluviatilis* in diferent geographic coordinates, and the temperature and altitude.

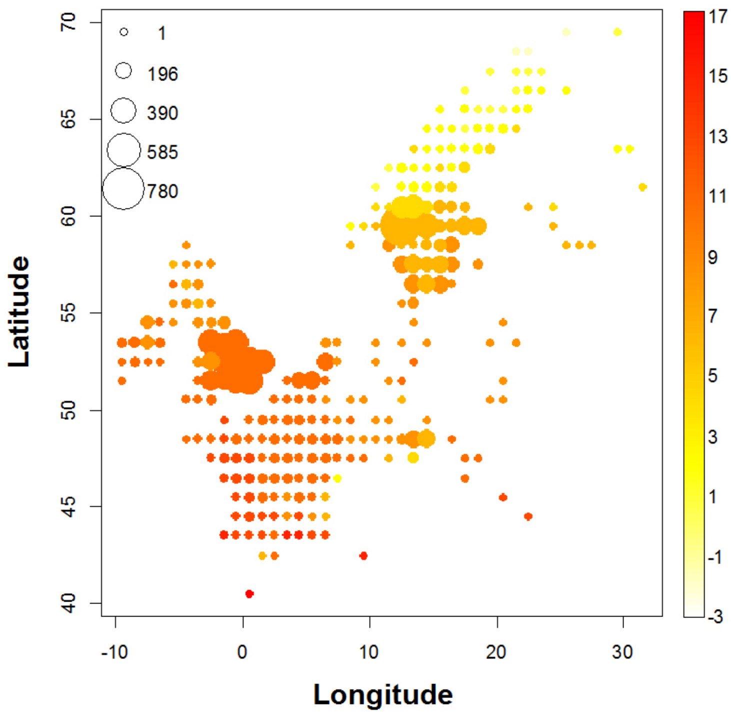
Example 1 The size of the bubble is according to the number of records for each latitude and longitude. The position and orientation of the size legend is changed with the arguments *legSpos="bottomright"* and *orientation="horizontal"*, respectively.



Example 2 The color gradient is according to the temperature for each latitude and longitude.



Example 3 Both bubble size and color gradient are used.



Value

A bubble chart is obtained.

References

Lemon, J., Bolker, B., Oom, S., Klein, E., Rowlingson, B., Wickham, H., Tyagi, A., Eterradossi, O., Grothendieck, G., Toews, M., Kane, J., Turner, R., Witthoft, C., Stander, J., Petzoldt, T., Duursma, R., Biancotto, E., Levy, O., Dutang, C., Solymos, P., Engelmann, R., Hecker, M., Steinbeck, F., Borchers, H., Singmann, H., Toal, T. & Ogle, D. (2015) Various plotting functions. R package version 3.5-11. Available at: `https://CRAN.R-project.org/package=plotrix`.

Examples

```
## Not run:

#Example 1

data(Z19)

F53(data=Z19, varY="Latitude", varX="Longitude", varSize="Records",
legSpos="bottomright", orientation="horizontal")

#Example 2
```

```
data(Z19)

F53(data=Z19, varY="Latitude", varX="Longitude", varColor="Temperature")

#Example 3

data(Z19)

F53(data=Z19, varY="Latitude", varX="Longitude", varSize="Records",
varColor="Temperature")

## End(Not run)
```

F54 *TERNARY DIAGRAMS*

Description

It performs a ternary diagram for one or several groups.

Usage

```
F54(data, varX, varY, varZ, group=NULL, mean=FALSE, cexpoint=1, cexmean=1,
cexaxis=1, cexlab=1.2, segments=TRUE, nseg=5, colseg="grey80", axisd=1, meand=2,
XLAB=NULL, YLAB=NULL, ZLAB=NULL, XLIM=NULL, YLIM=NULL, ZLIM=NULL,
COLOR=NULL, PCH=NULL, FAMILY="Arial", MAR=c(1,1,3,1), LEGEND=NULL,
MTEXT= NULL, TEXT=NULL)
```

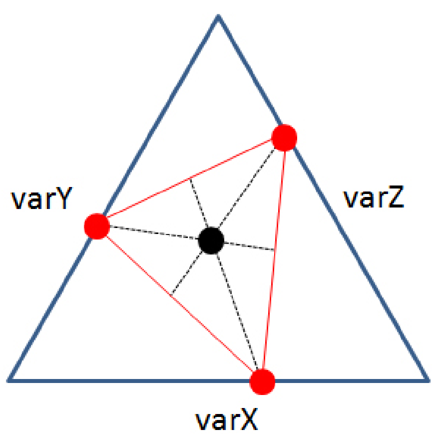
Arguments

`data`	Data file.
`varX`	Variable X.
`varY`	Variable Y.
`varZ`	Variable Z.
`group`	Variable with the categories to be grouped.
`mean`	If it is TRUE the mean of all values or the mean of each group (if the argument *group* is not NULL) is plotted.
`cexpoint`	Size of the symbols.
`cexmean`	Size of the labels of the means.
`cexaxis`	Size of the labels of the axes.
`cexlab`	Size of the legends of the axes.
`segments`	If it is TRUE, segments into the triangle are drawn.
`nseg`	Number of inside segments.
`colseg`	Color of inside segments.

axisd	Number of digits of the labels of the axes.
meand	Number of digits of the labels of the means.
XLAB	Legend of the X axis.
YLAB	Legend of the Y axis.
ZLAB	Legend of the Z axis.
XLIM	Vector with the limits of the X axis.
YLIM	Vector with the limits of the Y axis.
ZLIM	Vector with the limits of the Z axis.
COLOR	Color of the symbols. If the argument *group* is not NULL, it must be as many as different categories of the variable *group*.
PCH	Graphic symbol (see the description of the same argument in the function F1). It the argument *group* is not NULL, it must be as many as different categories of the variable *group*.
FAMILY	It specifies the font of the text.
MAR	A numeric vector with the format c(down, left, up, right) that defines the lines of the margins of the figure.
LEGEND	It allows to modify the legend.
MTEXT	It allows to add text on the margins of the graph.
TEXT	It allows to add text in any area of the inner part of the graph.

Details

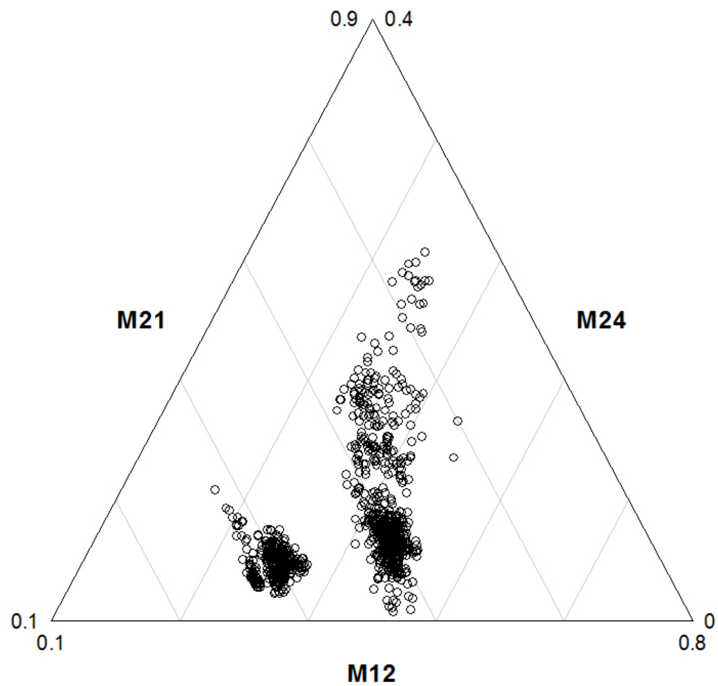
The barycenter of the triangle formed by the three variables was used as the centroid of the three variables. For further details see Guisande & Vammonde (2012).



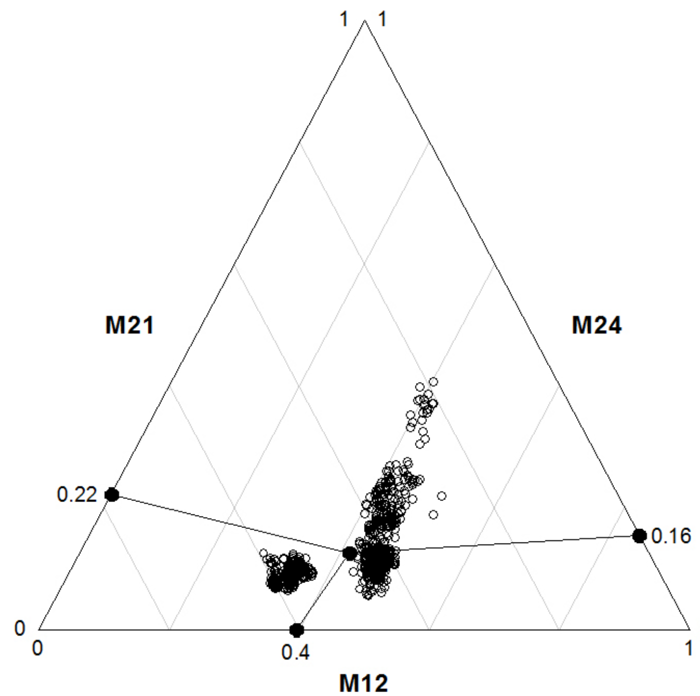
EXAMPLES

For the examples, morphometric data of three families of freshwater fishes, as the distance from the origin of the dorsal fin to the origin of the anal fin (M13), the length of the dorsal fin base (M12), body height (M11), etc., are used. For details see Guisande et al. (2010).

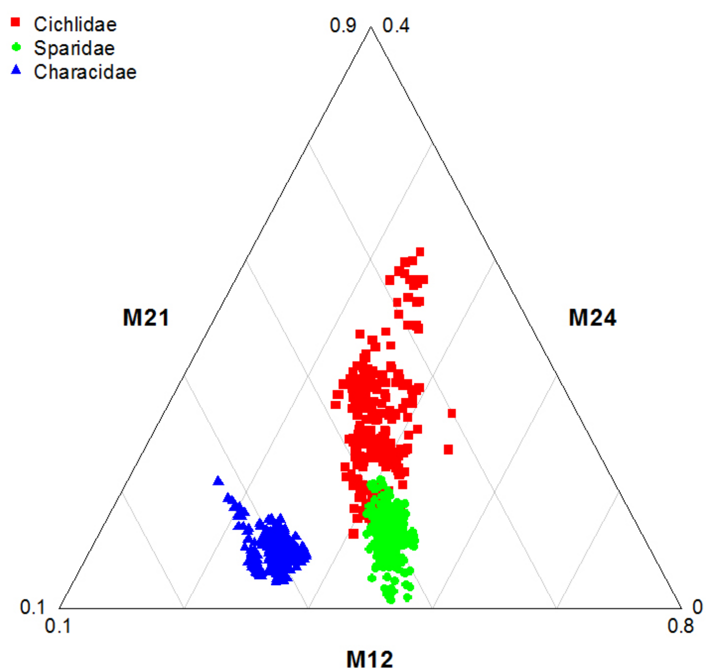
Example 1 The ternary diagram is performed with the variables M12, M23 and M24.



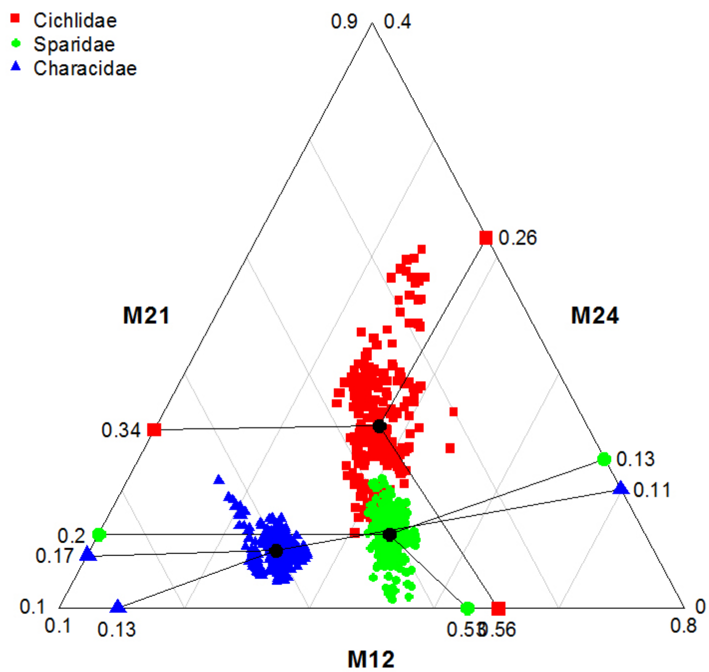
Example 2 The mean value is depicted with the argument *mean=TRUE* and the limits are modified.



Example 3 The different families are identified with the argument *group="Family"*.



Example 4 The mean value for each family is depicted with the argument *mean=TRUE*.



Value

A ternary diagram is obtained.

References

Guisande, C., Manjarrés-Hernández, A., Pelayo-Villamil, P., Granado-Lorencio, C., Riveiro, I., Acuña, A., Prieto-Piraquive, E., Janeiro, E., Matías, J.M., Patti, C., Patti, B., Mazzola, S., Jiménez, S., Duque, V. & Salmerón, F. (2010) IPez: An expert system for the taxonomic identification of fishes based on machine learning techniques. *Fisheries Research*, 102, 240-247.

Guisande, C. & Vaamonde, A. (2012) *Gráficos estadísticos y mapas con R*. Ediciones Díaz de Santos, Madrid, 367 pp.

Examples

```
## Not run:

#Example 1

data(Z8)

F54(data=Z8, varX="M12", varY="M21", varZ="M24")

#Example 2

data(Z8)

F54(data=Z8, varX="M12", varY="M21", varZ="M24", mean=TRUE, XLIM=c(0,1),
```

```
YLIM=c(0,1), ZLIM=c(0,1))

#Example 3

data(Z8)

F54(data=Z8, varX="M12", varY="M21", varZ="M24", group="Family")

#Example 4

data(Z8)

F54(data=Z8, varX="M12", varY="M21", varZ="M24", group="Family", mean=TRUE)

## End(Not run)
```

F55 *CONDITIONAL DENSITY PLOTS*

Description

It performs a conditional density plot describing how the distribution of a qualitative variable varies over a quantitative variable.

Usage

```
F55(data, varQuali, varQuanti, OrderCat=NULL, LabelCat=NULL, font.lab=2, cex.lab=14,
ylab_tol=0.05, bw="nrd0", n=512, main="", margins=c(5.1, 4.1, 4.1, 3.1),
XLAB=NULL, YLAB=NULL, XLIM=NULL, COLOR=NULL)
```

Arguments

data	Data file.
varQuali	Qualitative variable.
varQuanti	Quantitative variable.
OrderCat	It allows to specify a vector with the order in which the categories of the variable *varQuali* are shown.
LabelCat	It allows to specify a vector with the names of the categories of the variable *varQuali*.
font.lab	Font of the legend of the axes.
cex.lab	Size of the legend of the axes.
ylab_tol	Convenience tolerance parameter for y-axis annotation. If the distance between two labels drops under this threshold, they are plotted equidistantly.
bw	The smoothing bandwidth to be used. For details see bandwidth.
n	The number of equally spaced points at which the density is to be estimated.

main	Main title.
margins	Margins of the plot.
XLAB	Legend of the X axis.
YLAB	Legend of the Y axis.
XLIM	Vector with the limits of the X axis.
COLOR	Vector with the color of the categories or just one color for all categories.

Details

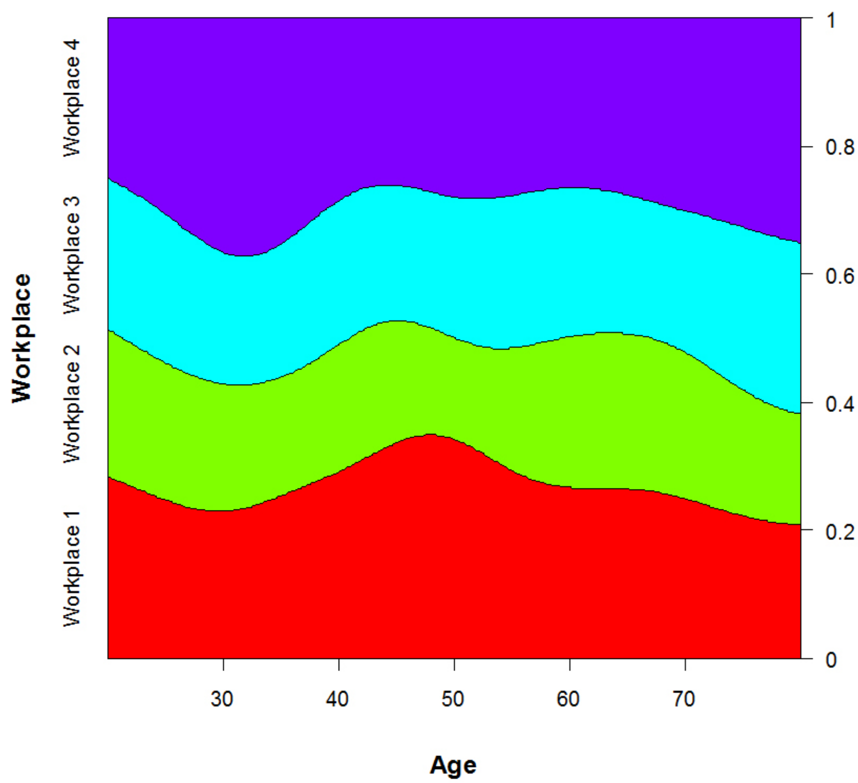
FUNCTIONS

The graph is performed with the function cd_plot of the package vcd (Meyer et al., 2006; 2008; 2015). For further details see Guisande & Vammonde (2012).

EXAMPLES

Smoking behaviour of men and women who smoke in different work centres.

The figure shows the relative proportion the of the persons interviewed in the four work centres according to their age.



Value

A conditional density plot is obtained.

References

Guisande, C. & Vaamonde, A. (2012) *Gráficos estadísticos y mapas con R*. Ediciones Díaz de Santos, Madrid, 367 pp.

Meyer, D., Zeileis, A. & Hornik, K. (2006) The strucplot framework: Visualizing multiway contingency tables with vcd. *Journal of Statistical Software*, 17: 1-48.

Meyer, D., Zeileis, A. &Hornik, K. (2008) Visualizing contingency tables. In Chun-Houh Chen, Wolfang Härdle, and Antony Unwin, editors, Handbook of Data Visualization, Springer Handbooks of Computational Statistics, pages 589-616. Springer-Verlag, New York. ISBN 978-3-540-33036-3.

Meyer, D., Zeileis, A. & Hornik, K. (2015) Visualizing Categorical Data. R package version 1.4-1. Available at: https://CRAN.R-project.org/package=vcd.

Examples

```
## Not run:

data(Z20)

F55(data=Z20, varQuali="Workplace", varQuanti="Age")

## End(Not run)
```

F56 *MOSAIC PLOT*

Description

It performs a mosaic plot of a contingency table.

Usage

```
F56(data, varX, varY, OrderCatX=NULL, LabelCatX=NULL, OrderCatY=NULL,
LabelCatY=NULL, shade=TRUE, cex.axis=1, MPLOT=NULL,  ResetPAR=TRUE,
PAR=NULL, XLAB=NULL, YLAB=NULL, COLOR=NULL)
```

Arguments

`data`	Data file.
`varX`	Qualitative variable X.
`varY`	Qualitative variable Y.
`OrderCatX`	It allows to specify a vector with the order in which the categories of the variable *varX* are shown.
`LabelCatX`	It allows to specify a vector with the names of the categories of the variable *varX*.
`OrderCatY`	It allows to specify a vector with the order in which the categories of the variable *varY* are shown.

`LabelCatY`	It allows to specify a vector with the names of the categories of the variable *varY*.
`shade`	If it is TRUE a numeric vector of at most 5 distinct positive numbers giving the absolute values of the cut points for the residuals.
`cex.axis`	Size of the labels of the axes.
`MPLOT`	It accesses the function mosaicplot that allows to modify the mosaic plot.
`ResetPAR`	If it is FALSE, the default condition of the function PAR is not placed and maintained those defined by the user in previous graphics.
`PAR`	It accesses the function PAR that allows to modify many different aspects of the graph.
`XLAB`	Legend of the X axis.
`YLAB`	Legend of the Y axis.
`COLOR`	Logical or a vector of colors for color shading, used only when shade is FALSE, or NULL (default). By default, grey boxes are drawn. color = TRUE uses a gamma-corrected grey palette. color = FALSE gives white boxes with no shading.

Details

FUNCTIONS

The mosaic plot is performed with the function mosaicplot of the base package graphics. For further details see Guisande & Vammonde (2012).

EXAMPLES

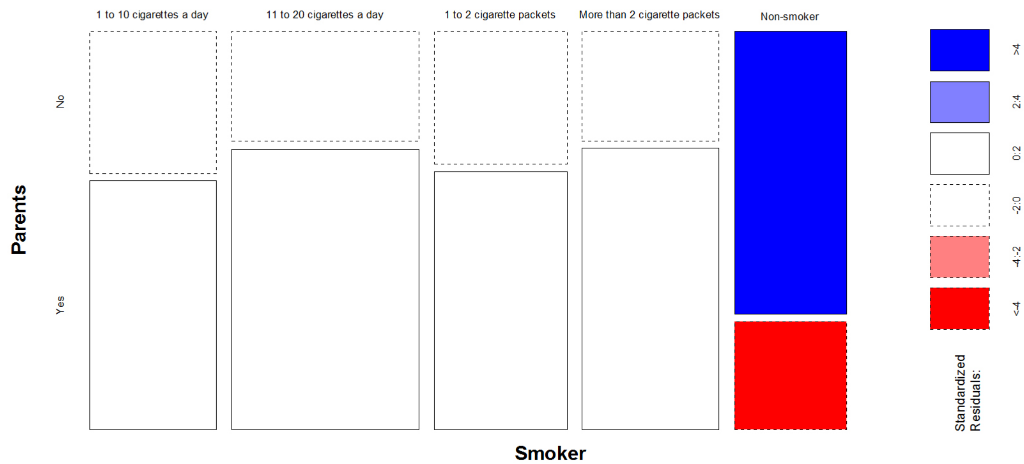
Smoking behaviour of men and women who smoke in different work centres.

Example 1 In the first example, the question is whether there are differences between the group of people with any of the smoking parents and the group that their parents do not smoke, in the proportion of different types of degrees of smoker.

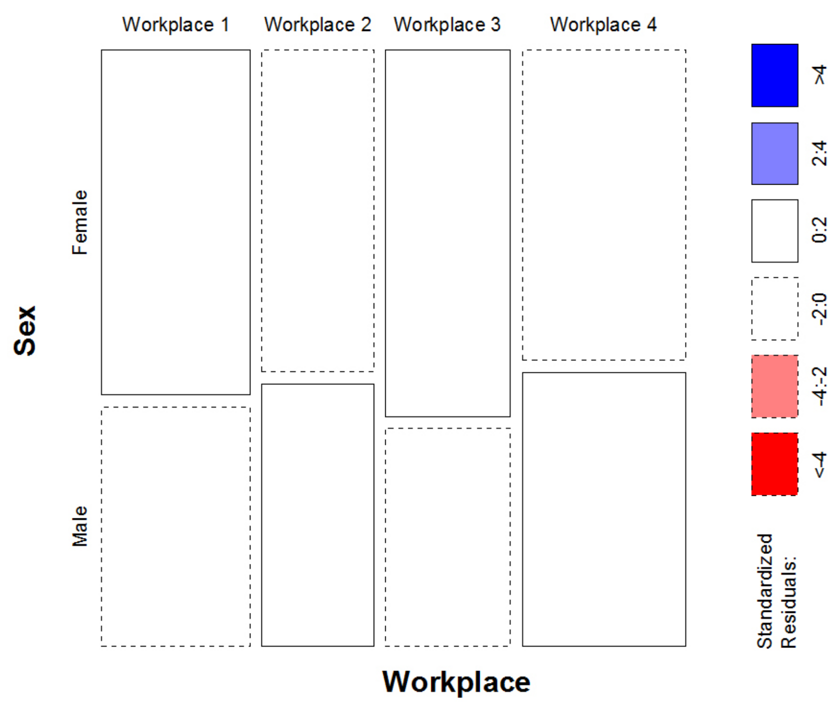
The figure shows the graphical representation of the contingency table. The categories of the variable X are ordered with the argument *OrcerCatX*.

This chart also shows the residuals of the test χ^2. As there are categories with color, the null hypothesis that the samples are homogeneous is rejected, that is to say, there are significant differences between the group with one of their smoking parents and the group without smoking parents, in the percentage of the different types of smokers. The chart also gives a very important additional information, the categories where the differences are significant and which are contributing to that, as a whole, the test χ^2 is significant.

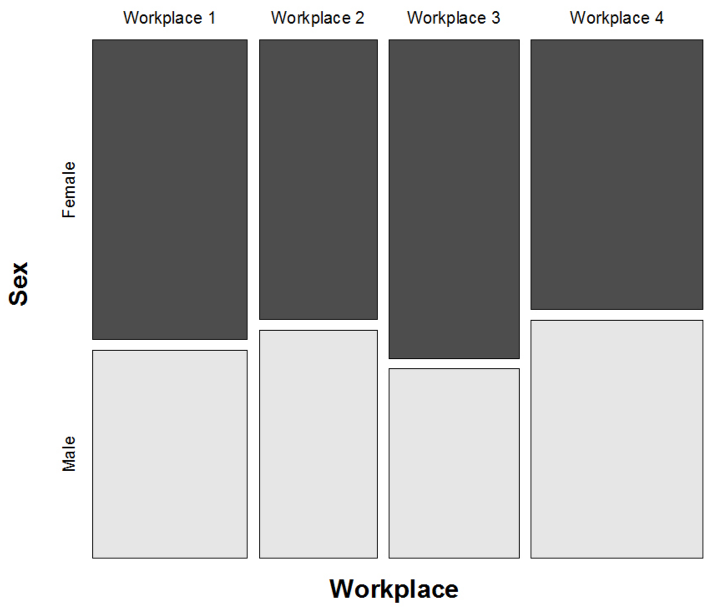
The white color categories are not significantly different, while the categories with color are significantly different. In particular, it notes that under the category of non-smoking parents, for both men and women, there is a significantly higher proportion of people who do not smoke (solid line). On the contrary, the number of people who do not smoke is significantly lower in the group of smoking parents (dashed line). Therefore, the fact that the parents do not smoke appears to foster their children not to smoke. However, once a person smokes, the degree to which smoke does not vary depending on whether the parents smoke or not smoke, as it could be observed that in all the categories of smokers, the color of the bars is white.



Example 2 The question is whether there are significant differences among working places in the proportion of males and females. As the color of all categories is white, there are not significant differences.



Example 3 As in the example 2, but as there are not significant differences, a grey palette is added with the argument *COLOR=TRUE*. To use the argument *COLOR*, it must be *shade=FALSE*.



Value

A mosaic plot is obtained.

References

Guisande, C. & Vaamonde, A. (2012) *Gráficos estadísticos y mapas con R*. Ediciones Díaz de Santos, Madrid, 367 pp.

Examples

```
## Not run:

#Example1

data(Z20)

F56(data=Z20, varX="Smoker", varY="Parents", OrderCatX=c("1 to 10 cigarettes a day",
"11 to 20 cigarettes a day", "1 to 2 cigarette packets", "More than 2 cigarette packets",
"Non-smoker"),cex.axis=0.8)

#Example 2

data(Z20)

F56(data=Z20, varX="Workplace", varY="Sex")
```

```
#Example 3

data(Z20)

F56(data=Z20, varX="Workplace", varY="Sex", shade=FALSE, COLOR=TRUE)

## End(Not run)
```

F57 *ASSOCIATION PLOT*

Description

It performs an association plot.

Usage

```
F57(data, varX, varY, varZ=NULL, OrderCatX=NULL, LabelCatX=NULL, OrderCatY=NULL,
LabelCatY=NULL, OrderCatZ=NULL, LabelCatZ=NULL, APLOT=NULL, shade=TRUE,
compress=TRUE, main="", family= "Arial", cex.axis=12, cex.lab=15, cex.main=17,
cex.legend=12, font.axis=1, font.lab=2, font.main=2, legend.text= "Pearson\nresiduals",
XLAB=NULL, YLAB=NULL, ZLAB=NULL)
```

Arguments

`data`	Data file.
`varX`	Qualitative variable X.
`varY`	Qualitative variable Y.
`varZ`	Qualitative variable Z.
`OrderCatX`	It allows to specify a vector with the order in which the categories of the variable *varX* are shown.
`LabelCatX`	It allows to specify a vector with the names of the categories of the variable *varX*.
`OrderCatY`	It allows to specify a vector with the order in which the categories of the variable *varY* are shown.
`LabelCatY`	It allows to specify a vector with the names of the categories of the variable *varY*.
`OrderCatZ`	It allows to specify a vector with the order in which the categories of the variable *varZ* are shown.
`LabelCatZ`	It allows to specify a vector with the names of the categories of the variable *varZ*.
`APLOT`	It accesses the function assoc that allows to modify the association plot.
`shade`	If it is TRUE the results of the statistical Chi square of Pearson are shown and, in addition, the categories that are significantly different are shaded.

`compress`	If it is FALSE the space between rows and columns is chosen so that the total of heights and widths of the rows and columns are equal. If TRUE, the space between rows and columns is fixed and, therefore, the graph is more compressed.
`main`	Title of the plot.
`family`	It specifies the font of the text.
`cex.axis`	Size of the labels of the axes.
`cex.lab`	Size of the text of the legends.
`cex.main`	Size of the graph title text.
`cex.legend`	Size of text in the bar legend.
`font.axis`	A numeric value that defines the font of the axis labels. The value 1 is a normal type, 2 is written in bold, 3 is written in italics and 4 is written in italics and bold.
`font.lab`	A numeric value that defines the font of the legends.
`font.main`	A numeric value that defines the font of the title of the graph.
`legend.text`	Text of the bar legend.
`XLAB`	Legend of the X axis.
`YLAB`	Legend of the Y axis.
`ZLAB`	Legend of the Z axis.

Details

FUNCTIONS

The graph is performed with the function assoc of the package vcd (Meyer et al., 2006; 2008; 2015). For further details see Guisande & Vammonde (2012).

EXAMPLES

Smoking behaviour of men and women who smoke in different work centres.

Example 1 In the first example, the question is whether there are differences between the group of people with any of the smoking parents and the group that their parents do not smoke, in the proportion of different types of degrees of smoker.

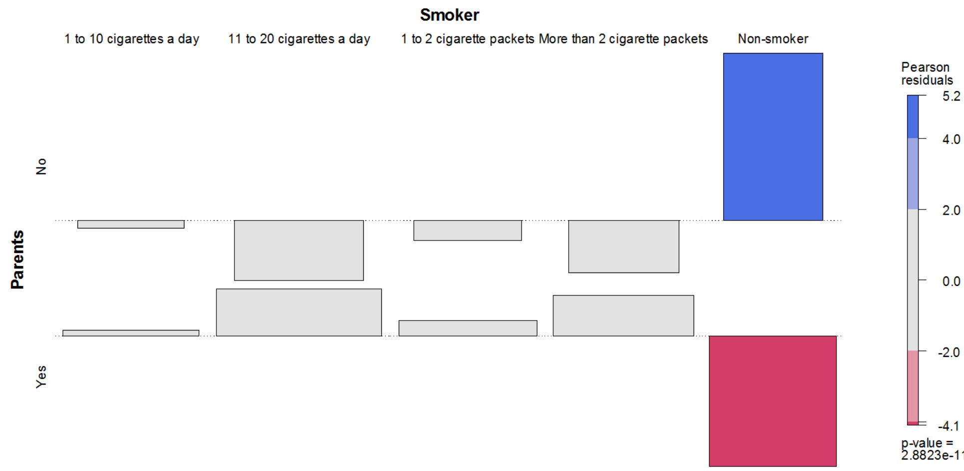
The figure shows the graphical representation of the contingency table. The categories of the variable X are ordered with the argument *OrcerCatX*.

This chart also shows the results of the test χ^2 with a $p < 0.001$. As there are categories with color, the null hypothesis that the samples are homogeneous is rejected, that is to say, there are significant differences between the group with one of their smoking parents and the group without smoking parents, in the percentage of the different types of smokers.

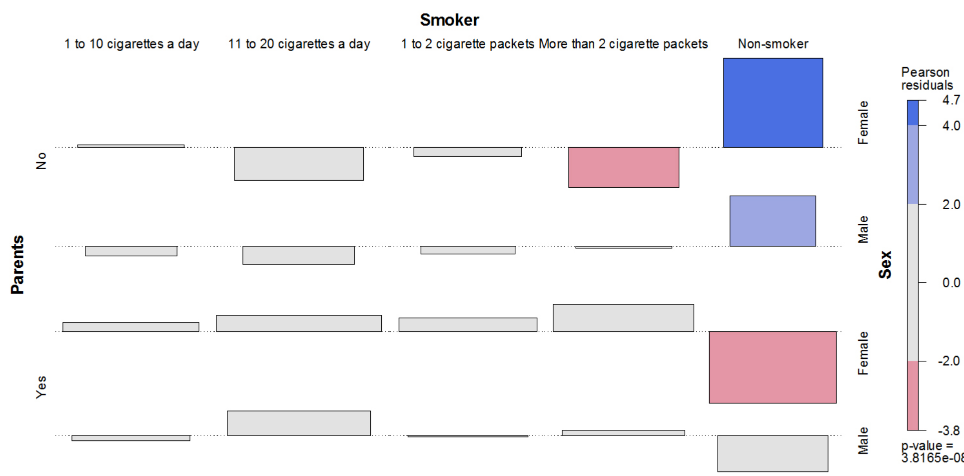
The chart also gives a very important additional information, the categories where the differences are significant and which are contributing to that, as a whole, the test χ^2 is significant.

The gray color categories are not significantly different, while the categories with color are significantly different. In particular, it notes that under the category of non-smoking parents, for both men and women, there is a significantly higher proportion of people who do not smoke (the bars are above the dotted line). On the contrary, the number of people who do not smoke is significantly lower in the group of smoking parents (the bar is below the dotted line).

Therefore, the fact that the parents do not smoke appears to foster their children not to smoke. However, once a person smokes, the degree to which smoke does not vary depending on whether the parents smoke or not smoke, as it could be observed that in all the categories of smokers, the color of the bars is gray.



Example 2 As in the example 1 but adding the variable Sex. The conclusions are the same than in the example 1.



Value

A association plot is obtained.

References

Guisande, C. & Vaamonde, A. (2012) *Gráficos estadísticos y mapas con R*. Ediciones Díaz de Santos, Madrid, 367 pp.

Meyer, D., Zeileis, A. & Hornik, K. (2006) The strucplot framework: Visualizing multiway contingency tables with vcd. *Journal of Statistical Software*, 17: 1-48.

Meyer, D., Zeileis, A. &Hornik, K. (2008) Visualizing contingency tables. In Chun-Houh Chen, Wolfang Härdle, and Antony Unwin, editors, Handbook of Data Visualization, Springer Handbooks of Computational Statistics, pages 589-616. Springer-Verlag, New York. ISBN 978-3-540-33036-3.

Meyer, D., Zeileis, A. & Hornik, K. (2015) Visualizing Categorical Data. R package version 1.4-1. Available at: https://CRAN.R-project.org/package=vcd.

Examples

```
## Not run:

#Example 1

data(Z20)

F57(data=Z20, varX="Smoker", varY="Parents", OrderCatX=c("1 to 10 cigarettes a day",
"11 to 20 cigarettes a day", "1 to 2 cigarette packets", "More than 2 cigarette packets",
"Non-smoker"))

#Example 2

data(Z20)

F57(data=Z20, varX="Smoker", varY="Parents", varZ="Sex", OrderCatX=c("1 to 10 cigarettes a day",
"11 to 20 cigarettes a day", "1 to 2 cigarette packets", "More than 2 cigarette packets",
"Non-smoker"))

## End(Not run)
```

F58 *PALEOCLIMATIC DIAGRAM*

Description

A paleoclimatic diagraman is performed.

Usage

```
F58(data, varY, varX, zones=NULL, zoneNames=NULL, STRATIPLOT=NULL, XLAB=NULL,
YLAB=NULL, YLIM=NULL, type=c("poly","g"), pch=16, cex=1, col.line="black",
col.symbol="black", col.refline="black", col.smooth="blue", col.poly="red",
col.zones="transparent", lty=1, lwd.h=1, lty.smooth=1, lwd.smooth=2,
lty.zones=1, lwd.zones=1)
```

Arguments

`data`	Data file.
`varY`	Variable Y.
`varX`	Variables X.
`zones`	A vector with the limits of the stratum.
`zoneNames`	Character vector with the name of the stratum of the argument *zones*.
`STRATIPLOT`	It accesses the function Stratiplot that allows to modify many different aspects of the diagram.
`XLAB`	Legend of the X axis.
`YLAB`	Legend of the Y axis.
`YLIM`	Limits of Y axis.
`type`	Type of plot. Character vector consisting of one or more of the following: "l", "p", "o", "b", "h", "g", "smooth" and "poly".
`pch`	Graphic symbol (see the description of the same argument in the function F1).
`cex`	Size of symbols.
`col.line`	Color of line.
`col.symbol`	Color of symbol.
`col.refline`	Color of inner lines.
`col.smooth`	Color of smooth line.
`col.poly`	Color of the polygons.
`col.zones`	Color of inner lines delimiting the zones.
`lty`	Type of line (see the description of the same argument in the function F1).
`lwd.h`	Line width.
`lty.smooth`	Type of smooth line.
`lwd.smooth`	Width of smooth line.
`lty.zones`	Type of inner lines delimiting the zones.
`lwd.zones`	Width of inner lines delimiting the zones.

Details

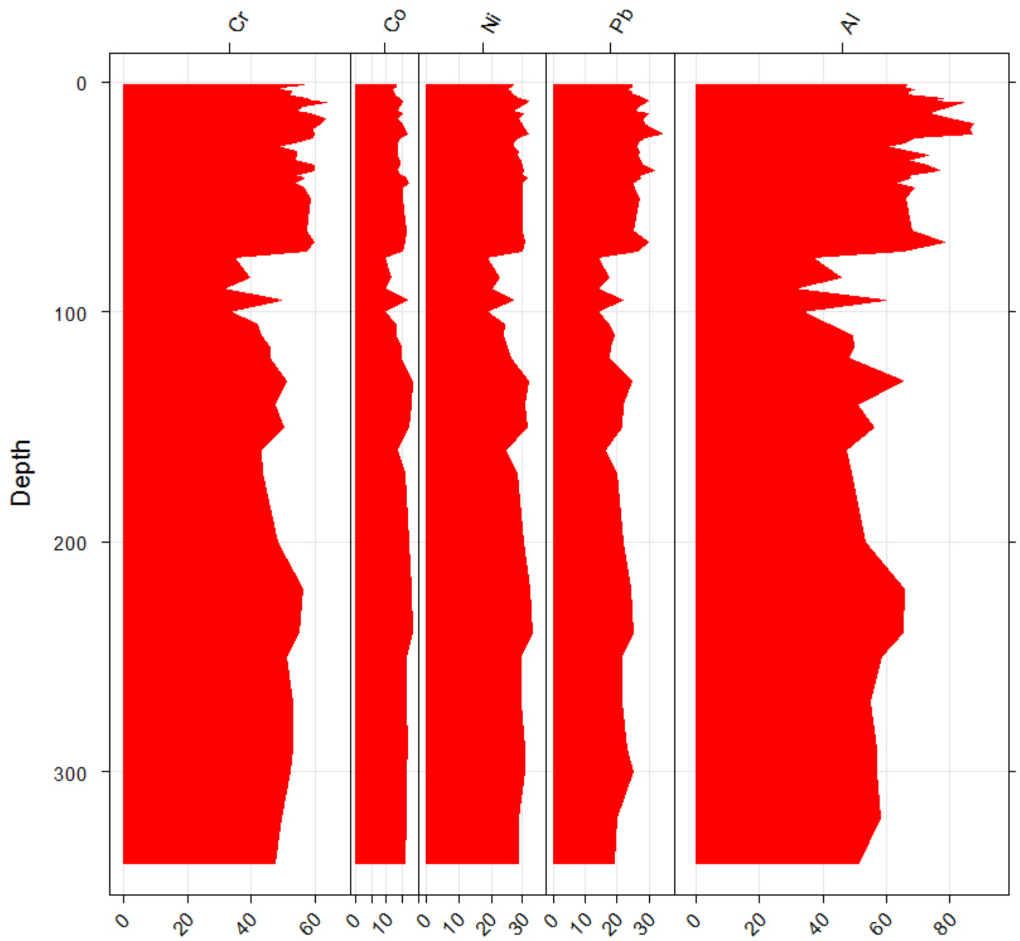
FUNCTIONS

The plot is performed with the function Stratiplot of the package analogue (Sinmpson, 2007; Simpson & Oksanen, 2015)

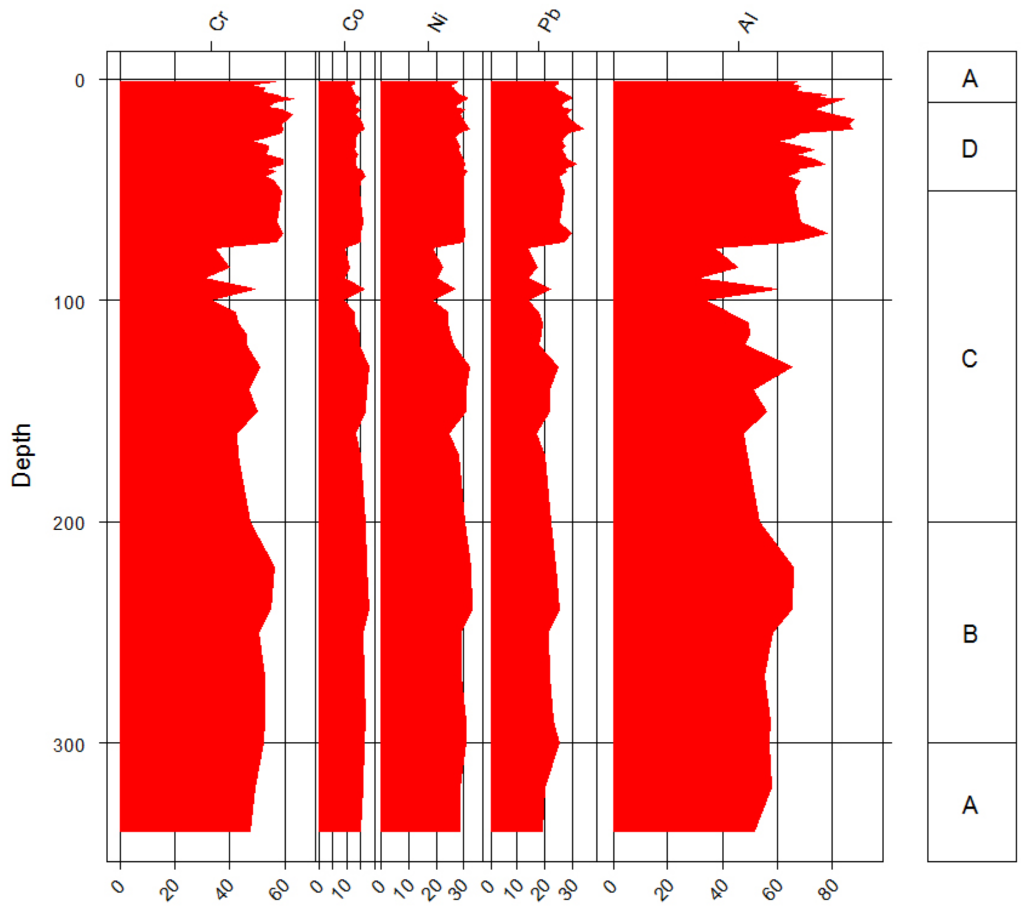
EXAMPLES

The concentration of metals in the sediment of one of the Yahuarkaka lakes (Leticia, Colombia) is used as example.

Example 1. Without stratum.



Example 2. With stratum.



Value

It is depicted a paleoclimatic diagram.

References

Simpson G.L. (2007) Analogue Methods in Palaeoecology: Using the analogue Package. *Journal of Statistical Software*, 22(2): 1-29.

Simpson, G.L. & Oksanen, J. (2015) Analogue and weighted averaging methods for palaeoecology. R package version 0.16-3. Available at: https://cran.R-project.org/package=analogue.

Examples

```
## Not run:

#Example 1. Without stratum

data(Z21)

F58(data=Z21, varY="Depth", varX=c("Cr","Co","Ni","Pb","Al"))
```

```
#Example 2. With stratum

data(Z21)

F58(data=Z21, varY="Depth", varX=c("Cr","Co","Ni","Pb","Al"),
zones=c(50,10,200,300), zoneNames=c("A","B","C","D"))

## End(Not run)
```

F59 *PLOTS INSIDE ANOTHER PLOT*

Description

It allows to embed up to 10 plots inside another plot.

Usage

```
F59(SPLOT, OMA1, SP1, OMA2=NULL, SP2=NULL, OMA3=NULL, SP3=NULL,
OMA4=NULL, SP4=NULL, OMA5=NULL, SP5=NULL, OMA6=NULL, SP6=NULL, OMA7=NULL,
SP7=NULL, OMA8=NULL, SP8=NULL, OMA9=NULL, SP9=NULL, OMA10=NULL, SP10=NULL)
```

Arguments

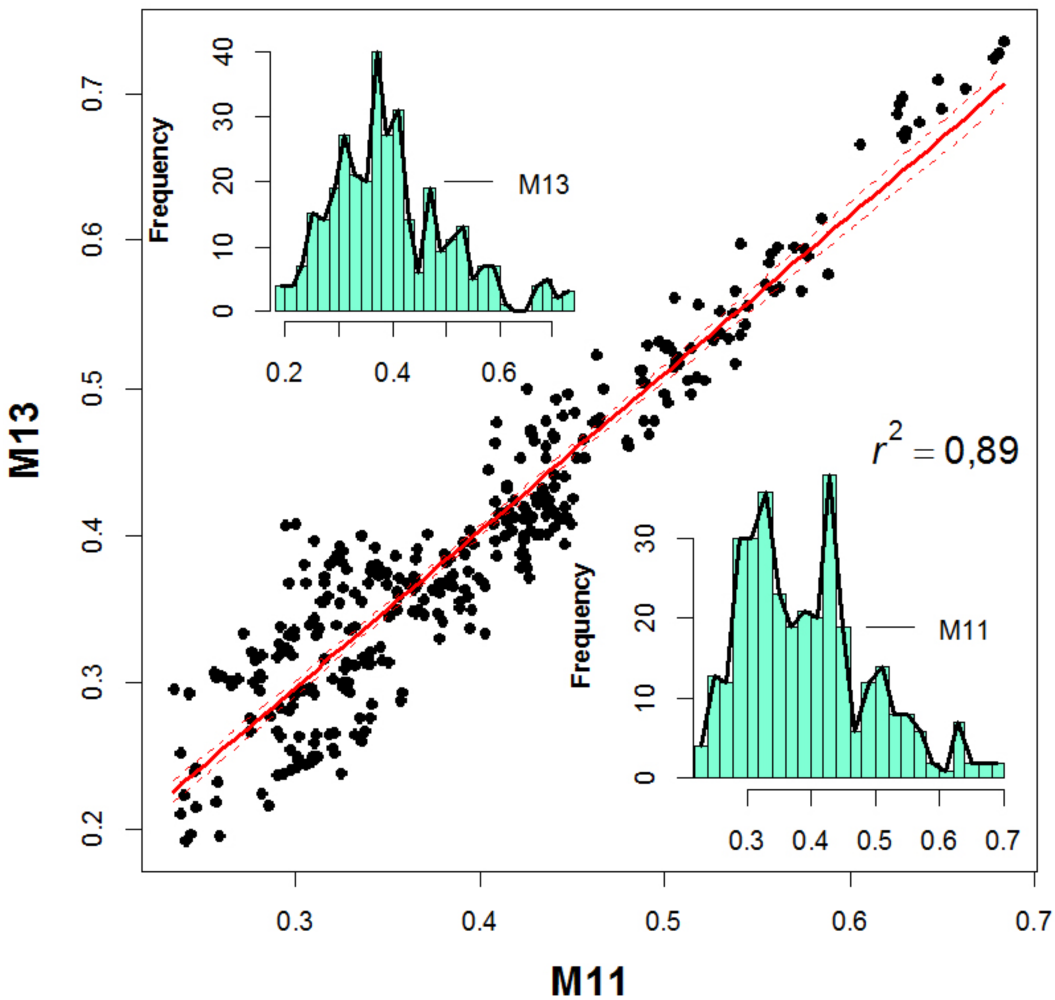
SPLOT	Name of the script of the main plot. The script must be in the working directory.
OMA1	Position of plot 1 inside the main plot. A vector c(bottom, left, top, right) with the number of lines inside the main plot.
SP1	Name of the script of the plot 1 inside the main plot. The script must be in the working directory. If it exists in the script the argument *ResetPAR*, it must be FALSE.
OMA2	As the argument *OMA1* but for the plot 2.
SP2	As the argument *SP1* but for the plot 2.
OMA3	As the argument *OMA1* but for the plot 3.
SP3	As the argument *SP1* but for the plot 3.
OMA4	As the argument *OMA1* but for the plot 4.
SP4	As the argument *SP1* but for the plot 4.
OMA5	As the argument *OMA1* but for the plot 5.
SP5	As the argument *SP1* but for the plot 5.
OMA6	As the argument *OMA1* but for the plot 6.
SP6	As the argument *SP1* but for the plot 6.
OMA7	As the argument *OMA1* but for the plot 7.
SP7	As the argument *SP1* but for the plot 7.

OMA8	As the argument *OMA1* but for the plot 8.
SP8	As the argument *SP1* but for the plot 8.
OMA9	As the argument *OMA1* but for the plot 9.
SP9	As the argument *SP1* but for the plot 9.
OMA10	As the argument *OMA1* but for the plot 10.
SP10	As the argument *SP1* but for the plot 10.

Details

EXAMPLES

The plot shows the relationship between the distance from the origin of the dorsal fin to the origin of the anal fin (M13) and body height (M11) of several species of Characiforms (Guisande et al., 2010), and the plots inside are the frequency histograms for each measurement.



It is just necessary a script for each of the plots to be combined, so one for the main plot and one for each of the plots embedded into the main plot. To obtain the above chart, follows the following steps:

1. Save the following script, which performs the main plot, with the name SPLOT.R in the working directory.

data(Z1)

F1(data=Z1, varY="M13", varX="M11", reg=TRUE, R2.pos="right")

2. Save the following script, which performs the first plot inside the main plot, with the name S1.R in the working directory.

F19(data=Z1, var="M11", line=TRUE , COLOR="#000000FF", HIST=c("xlab=xlab", "main=”", "ylab=ylab", "xlim=XLIM", "ylim=YLIM", "border=COLOR[h]", "col='#7FFFD4FF'"), ResetPAR=FALSE, PAR=c("cex.lab=0.9", "font.lab=2", "mar=c(5,5,3,2)"), LEGEND=c("x='right'","legend=dati", "col=COLOR", "lty=lty", "bty='n'"))

3. Save the following script, which performs the second plot inside the main plot, with the name S2.R in the working directory.

F19(data=Z1, var="M13", line=TRUE , COLOR="#000000FF", HIST=c("xlab=xlab", "main=”", "ylab=ylab", "xlim=XLIM", "ylim=YLIM", "border=COLOR[h]", "col='#7FFFD4FF'"), ResetPAR=FALSE, PAR=c("cex.lab=0.9", "font.lab=2", "mar=c(5,5,3,2)"), LEGEND=c("x='right'","legend=dati", "col=COLOR", "lty=lty", "bty='n'"))

4. Finally, you must run the script of the example and the following plot is obtained.

Value

It is possible to embed several plots inside another plot.

References

Guisande, C., Manjarrés-Hernández, A., Pelayo-Villamil, P., Granado-Lorencio, C., Riveiro, I., Acuña, A., Prieto-Piraquive, E., Janeiro, E., Matías, J.M., Patti, C., Patti, B., Mazzola, S., Jiménez, S., Duque, V. & Salmerón, F. (2010) IPez: An expert system for the taxonomic identification of fishes based on machine learning techniques. *Fisheries Research*, 102, 240-247.

Examples

```
## Not run:

F59(SPLOT="SP.R", OMA1=c(2.5,17,14,1), SP1="S1.R", OMA2=c(17,4,1,14), SP2="S2.R")

## End(Not run)
```

F60 *SCATTER PLOTS WITH MARGINAL HISTROGRAMS*

Description

It performs a simple scatter plot with or without text labels and a regression model, and marginal histograms.

Usage

```
F60(data, varY, varX, textlabel=NULL, label=NULL, MAR1=c(5,5,1,1),
MAR2=c(2,5,1,0), MAR3=c(5,1.5,0,1), reg=FALSE, model="Linear", outliers=FALSE,
quant1=0.05, quant2 = 0.95,  ci=TRUE, level=0.95, ResetPAR=FALSE, PAR=NULL,
XLAB=NULL, YLAB=NULL, COLOR="black", COLORR="red", PCH=16, lty=1, ltyci=2,
lwd=2.5, R2.pos="topleft", PLOT=NULL, LEGEND=NULL, AXIS=NULL, MTEXT= NULL,
TEXT=NULL, dec=",", file="Output.txt", HIST=NULL, HISTh=NULL, breaks=20,
COLORl=NULL, COLORb="grey", MTEXTh1= NULL, TEXTh1=NULL, MTEXTh2= NULL, TEXTh2=NULL)
```

Arguments

data	Data file.
varY	Dependent variable.
varX	Quantitative independent variable.
MAR1	A numeric vector with the format c(down, left, up, right) that defines the lines of the margins of the scatter plot.
MAR2	A numeric vector with the format c(down, left, up, right) that defines the lines of the margins of the upper histogram.
MAR3	A numeric vector with the format c(down, left, up, right) that defines the lines of the margins of the right side histogram.
textlabel	Variable with the text labels.
label	It allows to specify the characteristics of the text labels with the function text.
reg	If TRUE a regression model is performed.
model	One regression model can be selected: "Linear" , "Log", "S-curve", "Power", "Exp", "Quadratic", "Cubic", "Inverse". It is not considered the model in those cases in which there is the logarithm that apply to any of the variables, if any value of the variable, which applies the logarithm, is zero or negative. The inverse model is not calculated if any value of the independent variable is zero.
outliers	If it is TRUE, the outliers are removed using the selected regression model.
quant1	Quantile of the lower end to the elimination of outliers.
quant2	Quantile of the upper end to the elimination of outliers.
ci	If it is TRUE the confidence interval is depicted, but only for the linear regression model.
level	Tolerance/confidence level.

ResetPAR	If it is FALSE, the default condition of the function PAR is not placed and maintained those defined by the user in previous graphics.
PAR	It accesses the function PAR that allows to modify many different aspects of the graph.
XLAB	Legend of the X axis in the scatter plot.
YLAB	Legend of the Y axis in the scatter plot.
COLOR	Color of the symbols.
COLORR	Color of the line of the regression model.
PCH	Graphic symbol (see the description of the same argument in the function F1).
lty	Type of the regression line (see the description of the same argument in the function F1).
ltyci	Type of the confidence interval line (see the description of the same argument in the function F1).
lwd	Line width of the regression line.
R2.pos	If it is not NULL, with this argument is possible to specify the position of the r^2 of the regression in the scatter plot.
PLOT	It allows to specify the characteristics of the scatter plot with the function plot.default.
LEGEND	It allows to include a legend to the scatter plot.
AXIS	It allows to add axes to the scatter plot.
MTEXT	It allows to add text on the margins of the scatter plot.
TEXT	It allows to add text in any area of the inner part of the scatter plot.
dec	It defines if the comma "," is used as decimal separator or the dot ".".
file	TXT FILE. If the argument *reg=TRUE* a TXT file is saved with the information of the regression.
HIST	It allows to specify the characteristics of the upper histogram with the function hist.
HISTh	It allows to specify the characteristics of the right side histogram with the function barplot.
breaks	Number of intervals.
COLORl	Color of the borders. It must be as many as different variables.
COLORb	Color of ther bars. It must be as many as different variables.
MTEXTh1	It allows to add text on the margins of the upper side histrogram.
TEXTh1	It allows to add text in any area of the inner part of the upper side histrogram.
MTEXTh2	It allows to add text on the margins of the right side histogram.
TEXTh2	It allows to add text in any area of the inner part of the right side histogram.

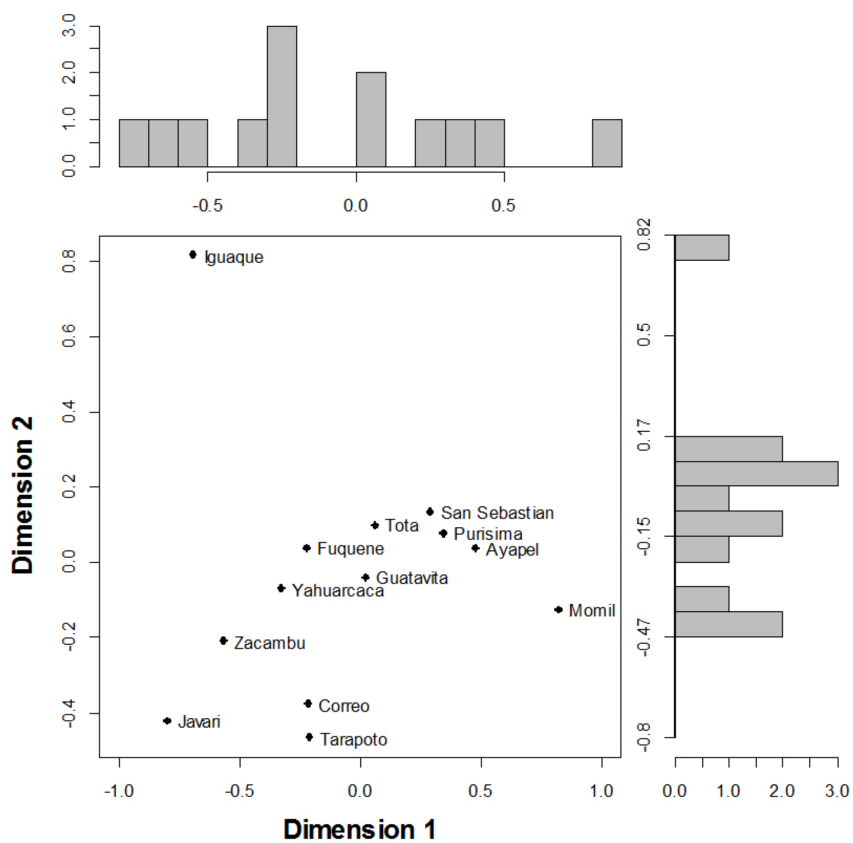
Details

FUNCTIONS

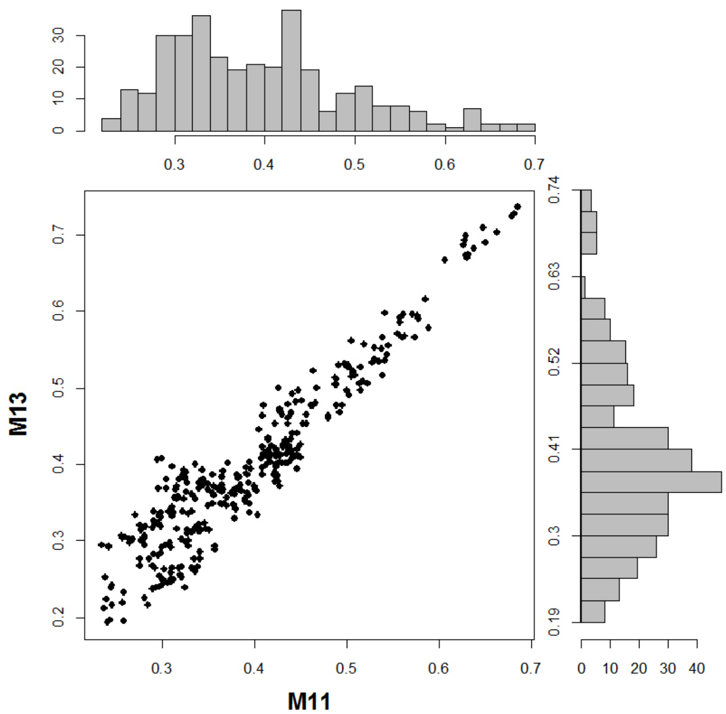
The scatter plot is performed with the function plot.default of base graphics package and the linear regression with the function lm of base stats package. The function lillie.test of the package nortest (Gross, 2013) is used to perform the test of Normality Kolmogorov-Smirnov with Lilliefors'correction, the function dwtest of the package lmtest (Hothorn et al., 2013) to analyze the autocorrelation with the test and the Durbin-Watson statistic function bptest of the package lmtest (Hothorn et al., 2013) to perform the Breusch-Pagan test of homoscedasticity. The histograms are performed with the functions hist and barplot of base graphics package.

EXAMPLES

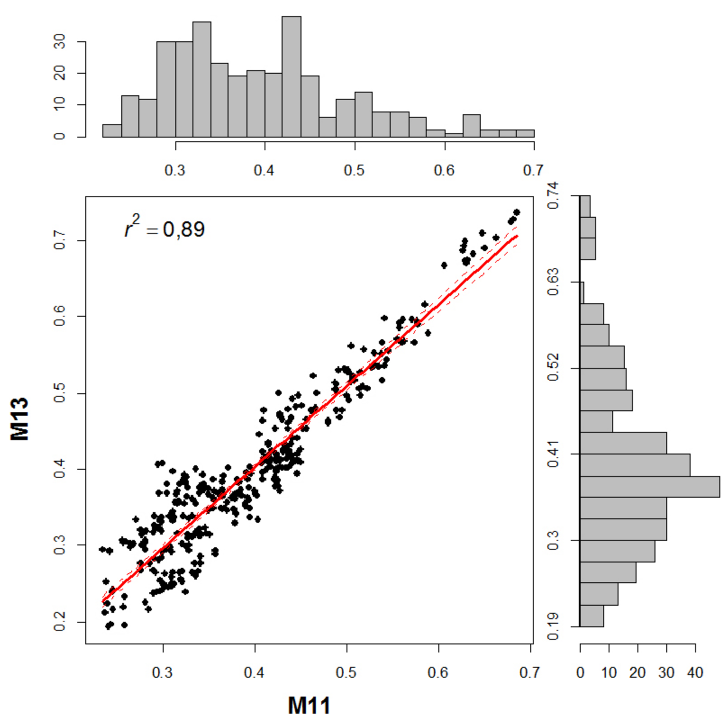
Example 1 The data are scores of a Principal Component Analysis (PCA) performed to physicochemical parameters from lakes in Colombia. In this example, text labels are assigned to the points with the argument *textlabel="Lake"*.



Example 2 For the examples, morphometric data of several fish species of Characiforms, as the distance from the origin of the dorsal fin to the origin of the anal fin (M13), the length of the dorsal fin base (M12), body height (M11), etc., are used. For details see Guisande et al. (2010). It is shown the relationship between M11 and M13 for all species.



Example 3 A linear regression line is added to the example 2 with the argument *reg=TRUE*.



For the explanation of the regression model shown in the TXT file, see function F1.

Value

A simple scatter plot with or without linear regression and marginal histrograms is obtained. Moreover, a TXT file is saved with the results of the regression model.

References

Durbin, J. & Watson G.S. (1951) Testing for serial correlation in least squares regression. *Biometrika*, **38**, 159-171.

Gross, J. (2013) Tests for Normality. R package version 1.0-2. Available at: https://CRAN.R-project.org/package=nortest.

Guisande, C., Manjarrés-Hernández, A., Pelayo-Villamil, P., Granado-Lorencio, C., Riveiro, I., Acuña, A., Prieto-Piraquive, E., Janeiro, E., Matías, J.M., Patti, C., Patti, B., Mazzola, S., Jiménez, S., Duque, V. & Salmerón, F. (2010) IPez: An expert system for the taxonomic identification of fishes based on machine learning techniques. *Fisheries Research*, 102, 240-247.

Hothorn, T. et al., (2013) Testing Linear Regression Models. R package version 0.9-33. Available at: https://CRAN.R-project.org/package=lmtest.

Examples

```
## Not run:

#Example 1

data(Z6)

F60(data=Z6, varY="Dimension2", varX="Dimension1", textlabel="Lake",
XLAB="Dimension 1", YLAB="Dimension 2",PLOT = c("xlim= c(-1,1)", "xlab=xlab",
"ylab=ylab", "col=COLOR", "pch=PCH"))

#Example 2

data(Z1)

F60(data=Z1, varY="M13", varX="M11")

#Example 3

F60(data=Z1, varY="M13", varX="M11", reg=TRUE)

## End(Not run)
```

F61 *SIMPLE MEAN WITH ERROR BARS SCATTER PLOTS, WITH TEXT LABELS AND REGRESSION, AND WITH MARGINAL HISTOGRAMS*

Description

It performs a simple mean with error bars scatter plot for variable X quantitativ, with text labels and a regression model, and with marginal histograms.

Usage

```
F61(data, varY,  varX, Factor, method="mean", dev="sd", barY=TRUE,
barX=FALSE, textlabel=FALSE, label=NULL,  MAR1=c(5,5,1,1), MAR2=c(2,5,1,0),
MAR3=c(5,1.5,0,1), reg=FALSE, model="Linear", outliers=FALSE, quant1=0.05,
quant2 = 0.95, ResetPAR=FALSE, PAR=NULL, XLAB=NULL, YLAB=NULL, XLIM=NULL,
YLIM=NULL,  COLOR="black", COLORI="black", COLORR="red", PCH=16, lty=3,
lwd=2.5, R2.pos="topleft", PLOT=NULL, LEGEND=NULL, AXIS=NULL, MTEXT= NULL,
TEXT=NULL, file1="Output.txt", file2="Average and error bars.csv", na="NA",
dec=",", row.names=FALSE, HIST=NULL, HISTh=NULL, breaks=20, COLORl=NULL,
COLORb="grey", MTEXTh1= NULL, TEXTh1=NULL, MTEXTh2= NULL, TEXTh2=NULL)
```

Arguments

data	Data file.
varY	Dependent variable.
varX	Quantitative independent variable.
Factor	Variable for the estimation of the average and error bars for each category of the variable. It is not possible to include variables with any of the categories with a single data, so if necessary several data for each category.
method	The average of each category of the grouped variable *Factor* is estimated with the "mean" or the "median".
dev	The error bars may be estimated using the standard deviation ("sd") or the standard error ("se").
barY	If it is TRUE the bar error of the variable Y is depicted.
barX	If it is TRUE the bar error of the variable X is depicted.
textlabel	If TRUE the text labels of the categories of the variable *Factor* are shown.
label	It allows to specify the characteristics of the text labels with the function text.
MAR1	A numeric vector with the format c(down, left, up, right) that defines the lines of the margins of the scatter plot.
MAR2	A numeric vector with the format c(down, left, up, right) that defines the lines of the margins of the upper histogram.
MAR3	A numeric vector with the format c(down, left, up, right) that defines the lines of the margins of the right side histogram.

`reg`	If it is TRUE a regression model is performed.
`model`	One regression model can be selected: "Linear" , "Log", "S-curve", "Power", "Exp", "Quadratic", "Cubic", "Inverse". It is not considered the model in those cases in which there is the logarithm that apply to any of the variables, if any value of the variable, which applies the logarithm, is zero or negative. The inverse model is not calculated if any value of the independent variable is zero.
`outliers`	If it is TRUE, the outliers are removed using the selected regression model.
`quant1`	Quantile of the lower end to the elimination of outliers.
`quant2`	Quantile of the upper end to the elimination of outliers.
`ResetPAR`	If it is FALSE, the default condition of the function PAR is not placed and maintained those defined by the user in previous graphics.
`PAR`	It accesses the function PAR that allows to modify many different aspects of the graph.
`XLAB`	Legend of the X axis in the scatter plot.
`YLAB`	Legend of the Y axis in the scatter plot.
`XLIM`	Vector with the limits of the X axis in the scatter plot.
`YLIM`	Vector with the limits of the Y axis in the scatter plot.
`COLOR`	Color of the symbols in the scatter plot.
`COLORI`	Color of the error bars in the scatter plot.
`COLORR`	Color of the line of the regression model in the scatter plot.
`PCH`	Graphic symbol (see the description of the same argument in the function F1).
`lty`	Type of the regression line (see the description of the same argument in the function F1).
`lwd`	Line width of the regression line relative to the default (default=1), so 2 is twice as wide.
`R2.pos`	If it is not NULL, with this argument is possible to specify the position of the r^2 of the regression in the scatter plot.
`PLOT`	It allows to specify the characteristics of the function plot.default.
`LEGEND`	It allows to include a legend to the graph.
`AXIS`	It allows to add axes to the graph.
`MTEXT`	It allows to add text on the margins of the graph.
`TEXT`	It allows to add text in any area of the inner part of the graph.
`file1`	TXT FILE. If the argument *reg=TRUE* a TXT file is saved with the information of the regression.
`file2`	CSV FILE. File name with the mean, median, standard error and standard deviation for each category of the variable *Factor*.
`na`	CSV FILES. Text that is used in the cells without data.
`dec`	CSV FILES. It defines if the comma "," is used as decimal separator or the dot ".".
`row.names`	CSV FILES. Logical value that defines if identifiers are put in rows or a vector with a text for each of the rows.

HIST	It allows to specify the characteristics of the upper histogram with the function hist.
HISTh	It allows to specify the characteristics of the right side histogram with the function barplot.
breaks	Number of intervals.
COLORl	Color of the borders. It must be as many as different variables.
COLORb	Color of ther bars. It must be as many as different variables.
MTEXTh1	It allows to add text on the margins of the upper side histrogram.
TEXTh1	It allows to add text in any area of the inner part of the upper side histrogram.
MTEXTh2	It allows to add text on the margins of the right side histogram.
TEXTh2	It allows to add text in any area of the inner part of the right side histogram.

Details

The equations of all regression models are in the section *details* of the function XI1 of the package StatR.

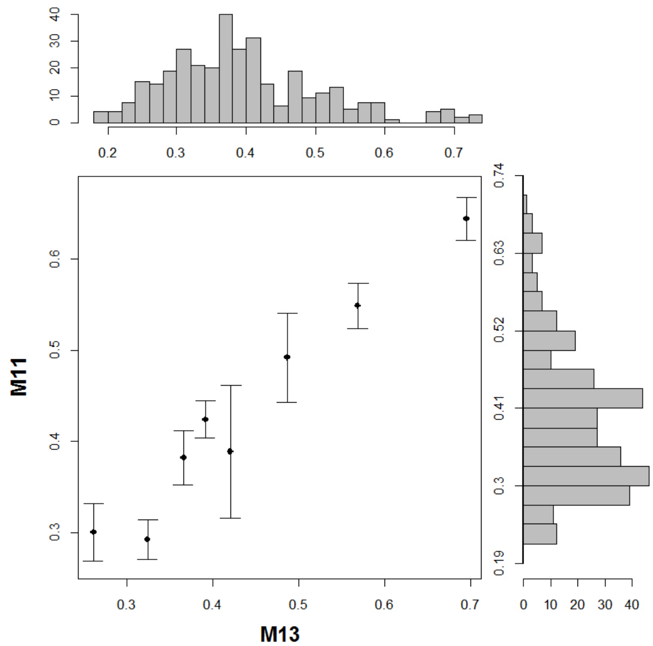
FUNCTIONS

All the functions used are the same than those described in function F22, and the histograms are performed with the functions hist and barplot of base graphics package.

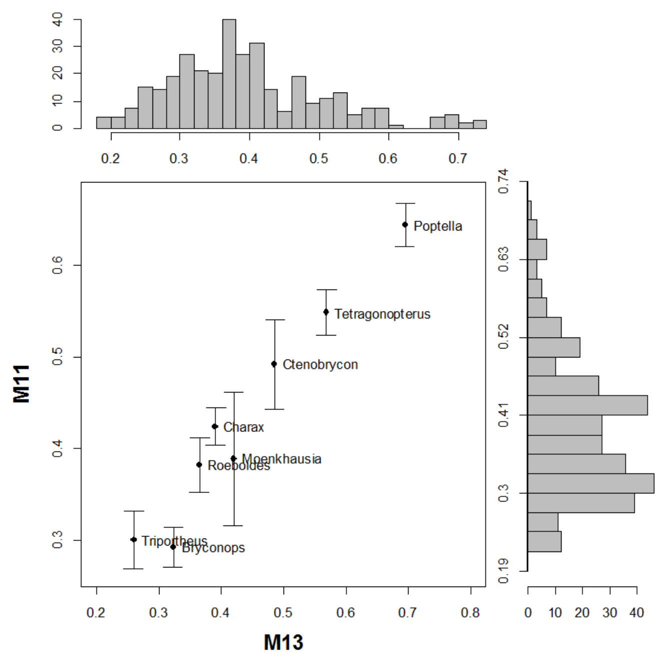
EXAMPLES

For the examples, morphometric data of several fish species of Characiforms are used. For details see Guisande et al. (2010). It is shown the relationship between M11 and M13 for all genera.

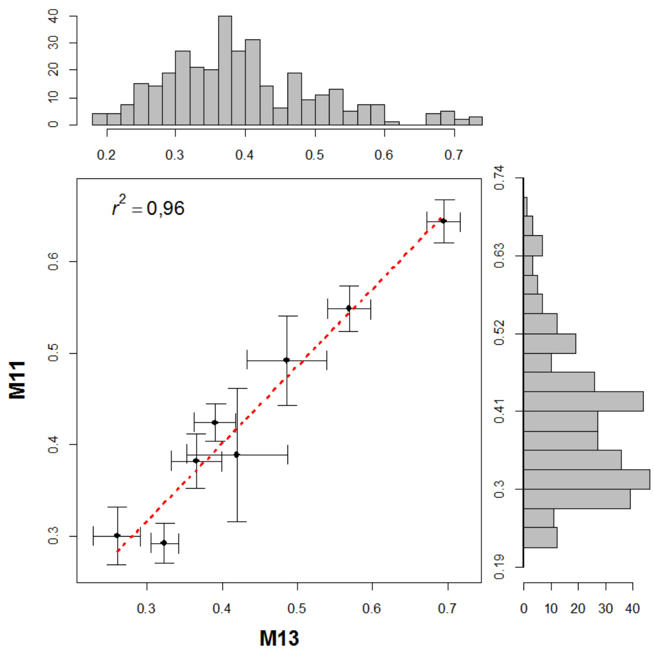
Example 1 Relationship between the mean values of M13 and M11 for each genera with the standard deviation of the M11.



Example 2 As in the example 1 but adding the text labels of the genera with the argument *textlabel=TRUE*.



Example 3 As in the example 1 but a linear regression line is added with the argument *reg=TRUE* and also is shown the standard deviation on the variable M13 with the argument *barX=TRUE*.



For the explanation of the regression model shown in the TXT file, see function F22.

Value

A simple scatter plot with mean error bars, with or without linear regression and with or without text labels, and with marginal histrograms is obtained. A CVS file with the mean, median, standard error and standard deviation for each category of the variable *Factor* is also obtained.

References

Durbin, J. & Watson G.S. (1951) Testing for serial correlation in least squares regression. *Biometrika*, **38**, 159-171.

Gross, J. (2013) Tests for Normality. R package version 1.0-2. Available at: https://CRAN.R-project.org/package=nortest.

Guisande, C., Manjarrés-Hernández, A., Pelayo-Villamil, P., Granado-Lorencio, C., Riveiro, I., Acuña, A., Prieto-Piraquive, E., Janeiro, E., Matías, J.M., Patti, C., Patti, B., Mazzola, S., Jiménez, S., Duque, V. & Salmerón, F. (2010) IPez: An expert system for the taxonomic identification of fishes based on machine learning techniques. *Fisheries Research*, 102, 240-247.

Hothorn, T. et al., (2013) Testing Linear Regression Models. R package version 0.9-33. Available at: https://CRAN.R-project.org/package=lmtest.

Examples

```
## Not run:

#Example 1
```

```
data(Z1)

F61(data=Z1, varY="M11", varX="M13", Factor="Genus")

#Example 2

F61(data=Z1, varY="M11", varX="M13", Factor="Genus", textlabel=TRUE, XLIM=c(0.2,0.8))

#Example 3

F61(data=Z1, varY="M11", varX="M13", Factor="Genus", barX=TRUE, reg=TRUE)

## End(Not run)
```

F62 *SCATTER PLOTS WITH MARGINAL BEANPLOTS*

Description

It performs a simple scatter plot with or without text labels and a regression model, and marginal beanplots.

Usage

```
F62(data, varY, varX, textlabel=NULL, label=NULL, MAR1=c(5,5,1,1),
MAR2=c(2,5,1,1), MAR3=c(5,1.5,1,1), reg=FALSE, model="Linear", outliers=FALSE,
quant1=0.05, quant2 = 0.95,  ci=TRUE, level=0.95, ResetPAR=FALSE, PAR=NULL,
XLAB=NULL, YLAB=NULL, COLOR="black", COLORR="red", PCH=16, lty=1, ltyci=2,
lwd=2.5, R2.pos="topleft", PLOT=NULL, LEGEND=NULL, AXIS=NULL, MTEXT= NULL,
TEXT=NULL, dec=",", file="Output.txt", BEANPLOT=NULL, COLORb="grey", ll=0.16)
```

Arguments

data	Data file.
varY	Dependent variable.
varX	Quantitative independent variable.
MAR1	A numeric vector with the format c(down, left, up, right) that defines the lines of the margins of the scatter plot.
MAR2	A numeric vector with the format c(down, left, up, right) that defines the lines of the margins of the upper beanplot.
MAR3	A numeric vector with the format c(down, left, up, right) that defines the lines of the margins of the right side beanplot.
textlabel	Variable with the text labels.
label	It allows to specify the characteristics of the text labels with the function text.
reg	If TRUE a regression model is performed.

`model`	One regression model can be selected: "Linear" , "Log", "S-curve", "Power", "Exp", "Quadratic", "Cubic", "Inverse". It is not considered the model in those cases in which there is the logarithm that apply to any of the variables, if any value of the variable, which applies the logarithm, is zero or negative. The inverse model is not calculated if any value of the independent variable is zero.
`outliers`	If it is TRUE, the outliers are removed using the selected regression model.
`quant1`	Quantile of the lower end to the elimination of outliers.
`quant2`	Quantile of the upper end to the elimination of outliers.
`ci`	If it is TRUE the confidence interval is depicted, but only for the linear regression model.
`level`	Tolerance/confidence level.
`ResetPAR`	If it is FALSE, the default condition of the function PAR is not placed and maintained those defined by the user in previous graphics.
`PAR`	It accesses the function PAR that allows to modify many different aspects of the graph.
`XLAB`	Legend of the X axis in the scatter plot.
`YLAB`	Legend of the Y axis in the scatter plot.
`COLOR`	Color of the symbols.
`COLORR`	Color of the line of the regression model.
`PCH`	Graphic symbol (see the description of the same argument in the function F1).
`lty`	Type of the regression line (see the description of the same argument in the function F1).
`ltyci`	Type of the confidence interval line (see the description of the same argument in the function F1).
`lwd`	Line width of the regression line.
`R2.pos`	If it is not NULL, with this argument is possible to specify the position of the r^2 of the regression in the scatter plot.
`PLOT`	It allows to specify the characteristics of the scatter plot with the function plot.default.
`LEGEND`	It allows to include a legend to the scatter plot.
`AXIS`	It allows to add axes to the scatter plot.
`MTEXT`	It allows to add text on the margins of the scatter plot.
`TEXT`	It allows to add text in any area of the inner part of the scatter plot.
`dec`	It defines if the comma "," is used as decimal separator or the dot ".".
`file`	TXT FILE. If the argument *reg=TRUE* a TXT file is saved with the information of the regression.
`BEANPLOT`	It allows to specify the characteristics of the beanplots with the function beanplot.
`COLORb`	A vector of up to four colors can be used in the following order: area of the beans (without the border, use border for that color), the lines inside the bean, the lines outside the bean, and the average line per bean.
`ll`	The length of the beanline per point found.

Details

FUNCTIONS

The scatter plot is performed with the function plot.default of base graphics package and the linear regression with the function lm of base stats package.

The function lillie.test of the package nortest (Gross, 2013) is used to perform the test of Normality Kolmogorov-Smirnov with Lilliefors'correction.

The function dwtest of the package lmtest (Hothorn et al., 2013) is used to analyze the autocorrelation with the test and the Durbin-Watson statistic.

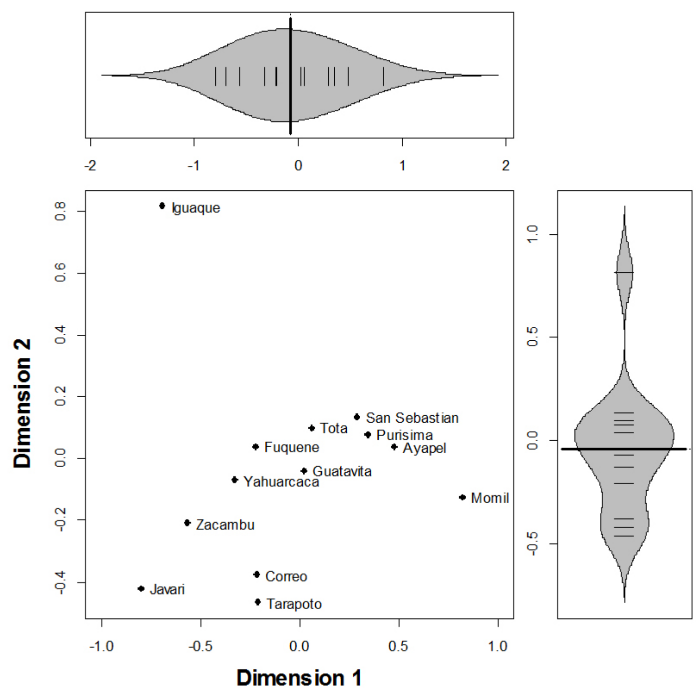
The function bptest of the package lmtest (Hothorn et al., 2013) is used to perform the Breusch-Pagan test of homoscedasticity.

The beanplots are performed with the function beanplot of the beanplot package (Kampstra, 2008; Kampstra, 2015).

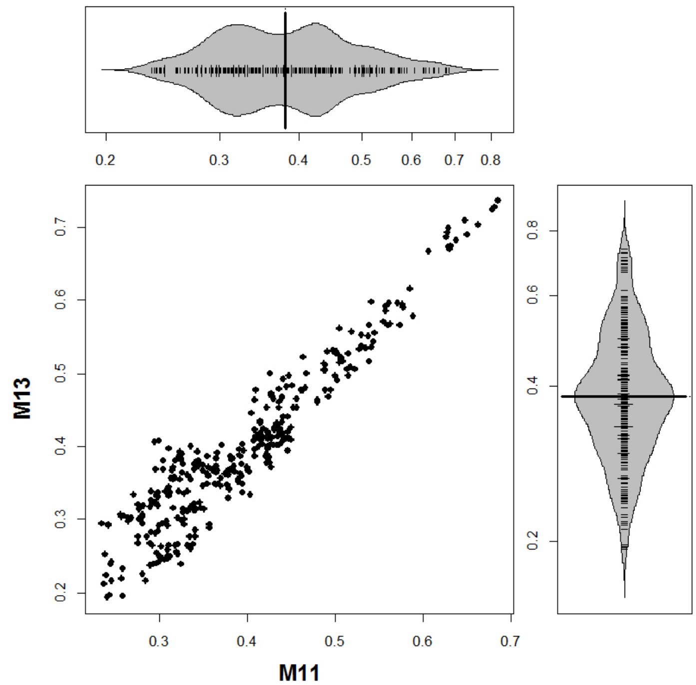
For further details see the help of the function beanplot and/or Guisande & Vammonde (2012).

EXAMPLES

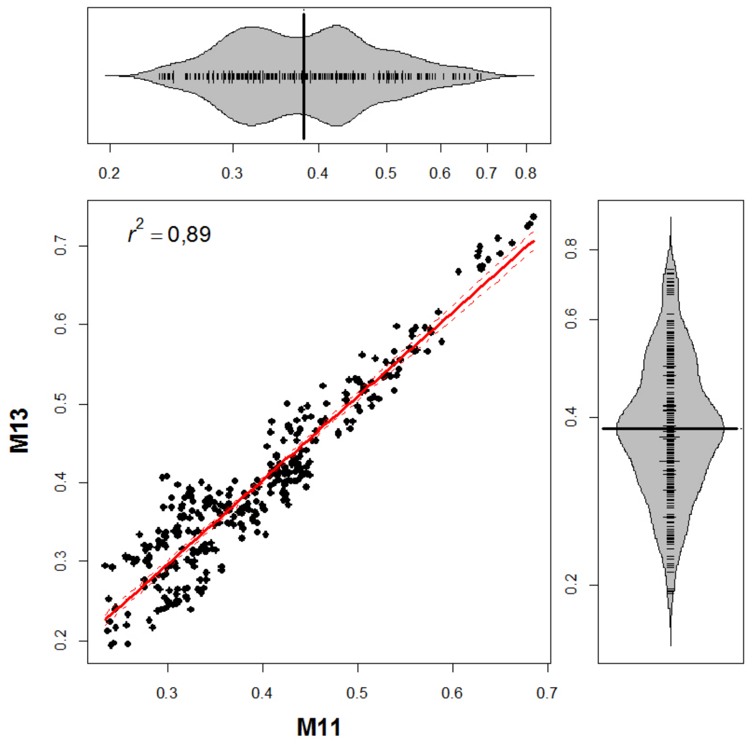
Example 1 The data are scores of a Principal Component Analysis (PCA) performed to physico-chemical parameters from lakes in Colombia. In this example, text labels are assigned to the points with the argument *textlabel="Lake"*.



Example 2 For the examples, morphometric data of several fish species of Characiforms are used (Guisande et al., 2010). It is shown the relationship between M11 and M13 for all species. The length of the lines inside the beanplot was modified with the argument *ll=0.05*.



Example 3 A linear regression line is added to the example 2 with the argument *reg=TRUE*.



For the explanation of the regression model shown in the TXT file, see function F1.

Value

A simple scatter plot with or without linear regression and marginal beanplots is obtained. Moreover, a TXT file is saved with the results of the regression model.

References

Durbin, J. & Watson G.S. (1951) Testing for serial correlation in least squares regression. *Biometrika*, **38**, 159-171.

Gross, J. (2013) Tests for Normality. R package version 1.0-2. Available at: `https://CRAN.R-project.org/package=nortest`.

Guisande, C., Manjarrés-Hernández, A., Pelayo-Villamil, P., Granado-Lorencio, C., Riveiro, I., Acuña, A., Prieto-Piraquive, E., Janeiro, E., Matías, J.M., Patti, C., Patti, B., Mazzola, S., Jiménez, S., Duque, V. & Salmerón, F. (2010) IPez: An expert system for the taxonomic identification of fishes based on machine learning techniques. *Fisheries Research*, 102, 240-247.

Guisande, C. & Vaamonde, A. (2012) *Gráficos estadísticos y mapas con R*. Ediciones Díaz de Santos, Madrid, 367 pp.

Hothorn, T. et al., (2013) Testing Linear Regression Models. R package version 0.9-33. Available at: `https://CRAN.R-project.org/package=lmtest`.

Kampstra, P (2008). Beanplot: A Boxplot Alternative for Visual Comparison of Distributions. *Journal of Statistical Software, Code Snippets*, 28: 1-9.

Kampstra, P (2015) Visualization via Beanplots (like Boxplot/Stripchart/Violin Plot). R package version 1.2. Available at: https://CRAN.R-project.org/package=beanplot.

Examples

```
## Not run:

#Example 1

data(Z6)

F62(data=Z6, varY="Dimension2", varX="Dimension1", textlabel="Lake",
XLAB="Dimension 1", YLAB="Dimension 2",PLOT = c("xlim= c(-1,1)", "xlab=xlab",
"ylab=ylab", "col=COLOR", "pch=PCH"))

#Example 2

data(Z1)

F62(data=Z1, varY="M13", varX="M11", ll=0.05)

#Example 3

F62(data=Z1, varY="M13", varX="M11", reg=TRUE, ll=0.05)

## End(Not run)
```

F63 *SIMPLE MEAN WITH ERROR BARS SCATTER PLOTS, WITH TEXT LABELS AND REGRESSION, AND WITH MARGINAL BEANPLOTS*

Description

It performs a simple mean with error bars scatter plot for variable X quantitativ, with text labels and a regression model, and with marginal beanplots.

Usage

```
F63(data, varY,  varX, Factor, method="mean", dev="sd", barY=TRUE,
barX=FALSE, textlabel=FALSE, label=NULL,  MAR1=c(5,5,1,1), MAR2=c(2,5,1,1),
MAR3=c(5,1.5,1,1), reg=FALSE, model="Linear", outliers=FALSE, quant1=0.05,
quant2 = 0.95, ResetPAR=FALSE, PAR=NULL, XLAB=NULL, YLAB=NULL, XLIM=NULL,
YLIM=NULL,  COLOR="black", COLORI="black", COLORR="red", PCH=16, lty=3,
lwd=2.5, R2.pos="topleft", PLOT=NULL, LEGEND=NULL, AXIS=NULL, MTEXT= NULL,
TEXT=NULL, file1="Output.txt", file2="Average and error bars.csv", na="NA",
dec=",", row.names=FALSE, BEANPLOT=NULL, COLORb="grey", ll=0.16)
```

Arguments

`data`	Data file.
`varY`	Dependent variable.
`varX`	Quantitative independent variable.
`Factor`	Variable for the estimation of the average and error bars for each category of the variable. It is not possible to include variables with any of the categories with a single data, so if necessary several data for each category.
`method`	The average of each category of the grouped variable *Factor* is estimated with the "mean" or the "median".
`dev`	The error bars may be estimated using the standard deviation ("sd") or the standard error ("se").
`barY`	If it is TRUE the bar error of the variable Y is depicted.
`barX`	If it is TRUE the bar error of the variable X is depicted.
`textlabel`	If TRUE the text labels of the categories of the variable *Factor* are shown.
`label`	It allows to specify the characteristics of the text labels with the function text.
`MAR1`	A numeric vector with the format c(down, left, up, right) that defines the lines of the margins of the scatter plot.
`MAR2`	A numeric vector with the format c(down, left, up, right) that defines the lines of the margins of the upper beanplot.
`MAR3`	A numeric vector with the format c(down, left, up, right) that defines the lines of the margins of the right side beanplot.
`reg`	If it is TRUE a regression model is performed.
`model`	One regression model can be selected: "Linear" , "Log", "S-curve", "Power", "Exp", "Quadratic", "Cubic", "Inverse". It is not considered the model in those cases in which there is the logarithm that apply to any of the variables, if any value of the variable, which applies the logarithm, is zero or negative. The inverse model is not calculated if any value of the independent variable is zero.
`outliers`	If it is TRUE, the outliers are removed using the selected regression model.
`quant1`	Quantile of the lower end to the elimination of outliers.
`quant2`	Quantile of the upper end to the elimination of outliers.
`ResetPAR`	If it is FALSE, the default condition of the function PAR is not placed and maintained those defined by the user in previous graphics.
`PAR`	It accesses the function PAR that allows to modify many different aspects of the graph.
`XLAB`	Legend of the X axis in the scatter plot.
`YLAB`	Legend of the Y axis in the scatter plot.
`XLIM`	Vector with the limits of the X axis in the scatter plot.
`YLIM`	Vector with the limits of the Y axis in the scatter plot.
`COLOR`	Color of the symbols in the scatter plot.
`COLORI`	Color of the error bars in the scatter plot.

`COLORR`	Color of the line of the regression model in the scatter plot.
`PCH`	Graphic symbol (see the description of the same argument in the function F1).
`lty`	Type of the regression line (see the description of the same argument in the function F1).
`lwd`	Line width of the regression line relative to the default (default=1), so 2 is twice as wide.
`R2.pos`	If it is not NULL, with this argument is possible to specify the position of the r^2 of the regression in the scatter plot.
`PLOT`	It allows to specify the characteristics of the function plot.default.
`LEGEND`	It allows to include a legend to the graph.
`AXIS`	It allows to add axes to the graph.
`MTEXT`	It allows to add text on the margins of the graph.
`TEXT`	It allows to add text in any area of the inner part of the graph.
`file1`	TXT FILE. If the argument *reg=TRUE* a TXT file is saved with the information of the regression.
`file2`	CSV FILE. File name with the mean, median, standard error and standard deviation for each category of the variable *Factor*.
`na`	CSV FILES. Text that is used in the cells without data.
`dec`	CSV FILES. It defines if the comma "," is used as decimal separator or the dot ".".
`row.names`	CSV FILES. Logical value that defines if identifiers are put in rows or a vector with a text for each of the rows.
`BEANPLOT`	It allows to specify the characteristics of the beanplots with the function beanplot.
`COLORb`	A vector of up to four colors can be used in the following order: area of the beans (without the border, use border for that color), the lines inside the bean, the lines outside the bean, and the average line per bean.
`ll`	The length of the beanline per point found.

Details

The equations of all regression models are in the section *details* of the function XI1 of the package StatR.

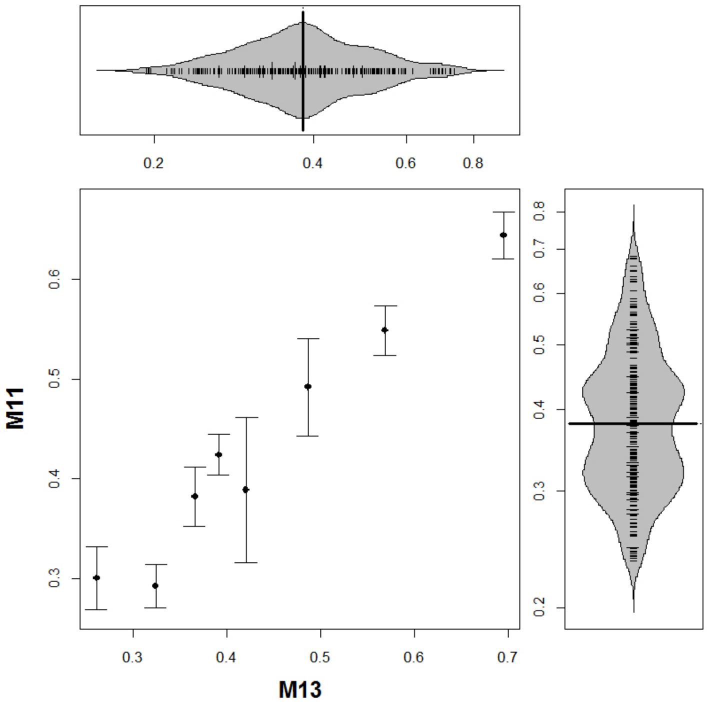
FUNCTIONS

All the functions used are the same than those described in function F22, and the beanplots are performed with the function beanplot of the beanplot package (Kampstra, 2008; Kampstra, 2015). For further details see the help of the function beanplot and/or Guisande & Vammonde (2012).

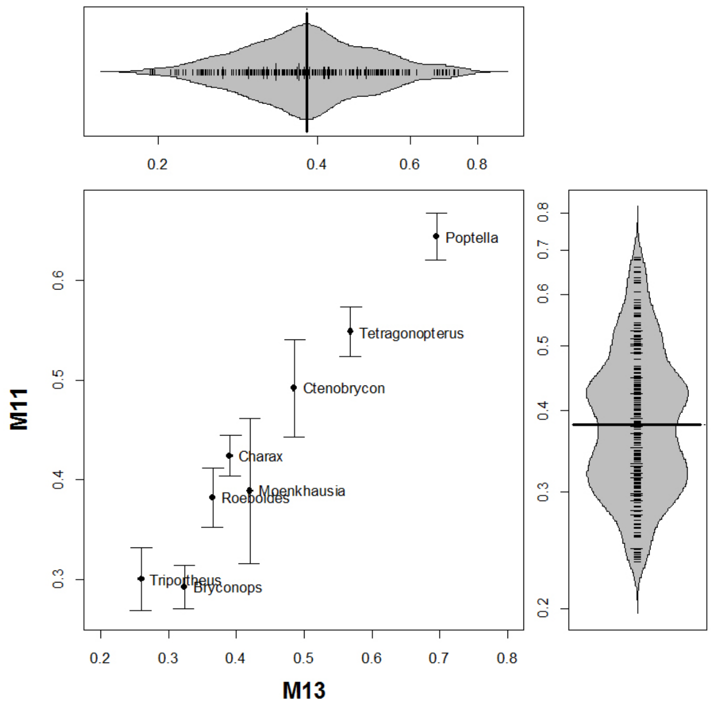
EXAMPLES

For the examples, morphometric data of several fish species of Characiforms are used. For details see Guisande et al. (2010). It is shown the relationship between M11 and M13 for all genera.

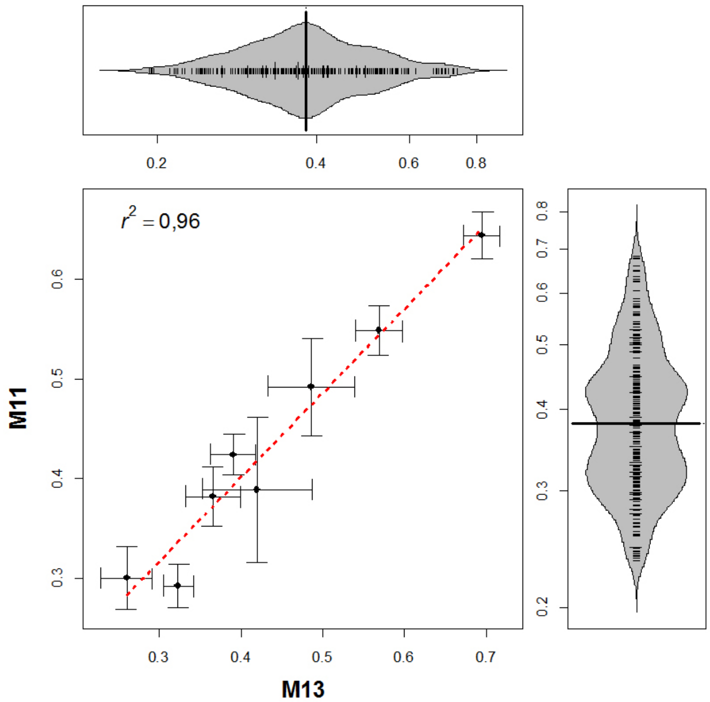
Example 1 Relationship between the mean values of M13 and M11 for each genera with the standard deviation of the M11. The length of the lines inside the beanplot was modified with the argument *ll=0.05*.



Example 2 As in the example 1 but adding the text labels of the genera with the argument *textlabel=TRUE*.



Example 3 As in the example 1 but a linear regression line is added with the argument *reg=TRUE* and also is shown the standard deviation on the variable M13 with the argument *barX=TRUE*.



For the explanation of the regression model shown in the TXT file, see function F22.

Value

A simple scatter plot with mean error bars, with or without linear regression and with or without text labels, and with marginal beanplots is obtained. A CVS file with the mean, median, standard error and standard deviation for each category of the variable *Factor* is also obtained.

References

Durbin, J. & Watson G.S. (1951) Testing for serial correlation in least squares regression. *Biometrika*, **38**, 159-171.

Gross, J. (2013) Tests for Normality. R package version 1.0-2. Available at: `https://CRAN.R-project.org/package=nortest`.

Guisande, C., Manjarrés-Hernández, A., Pelayo-Villamil, P., Granado-Lorencio, C., Riveiro, I., Acuña, A., Prieto-Piraquive, E., Janeiro, E., Matías, J.M., Patti, C., Patti, B., Mazzola, S., Jiménez, S., Duque, V. & Salmerón, F. (2010) IPez: An expert system for the taxonomic identification of fishes based on machine learning techniques. *Fisheries Research*, 102, 240-247.

Guisande, C. & Vaamonde, A. (2012) *Gráficos estadísticos y mapas con R*. Ediciones Díaz de Santos, Madrid, 367 pp.

Hothorn, T. et al., (2013) Testing Linear Regression Models. R package version 0.9-33. Available at: `https://CRAN.R-project.org/package=lmtest`.

Kampstra, P (2008). Beanplot: A Boxplot Alternative for Visual Comparison of Distributions. *Journal of Statistical Software, Code Snippets*, 28: 1-9.

Kampstra, P (2015) Visualization via Beanplots (like Boxplot/Stripchart/Violin Plot). R package version 1.2. Available at: https://CRAN.R-project.org/package=beanplot.

Examples

```
## Not run:

#Example 1

data(Z1)

F63(data=Z1, varY="M11", varX="M13", Factor="Genus", ll=0.05)

#Example 2

F63(data=Z1, varY="M11", varX="M13", Factor="Genus", textlabel=TRUE, XLIM=c(0.2,0.8), ll=0.05)

#Example 3

F63(data=Z1, varY="M11", varX="M13", Factor="Genus", barX=TRUE, reg=TRUE, ll=0.05)

## End(Not run)
```

F64 *SIMPLE SCATTER PLOT FOR LARGE DATASETS*

Description

It performs a simple scatter plot for large datasets, where the colors encode the density of the points in the scatter plot.

Usage

```
F64(data, varY, varX, IPLOT=NULL, pixs=3, MAX="zmax", ResetPAR=TRUE, PAR=NULL,
XLAB=NULL, YLAB=NULL, COLOR=IDPcolorRamp, MTEXT= NULL, TEXT=NULL)
```

Arguments

data	Data file.
varY	Dependent variable.
varX	Quantitative independent variable.
IPLOT	It allows to specify the characteristics of the plot with the function iplot.
pixs	Pixelsize in mm.
MAX	When NULL, the density in the scatter plot is encoded from 0 to maximum number of counts per pixel observed. When "zmax", the color legend ranges from the minimum to the maximum number of counts per pixel. It may be also numeric indicating the maximum of the color legend.

ResetPAR	If it is FALSE, the default condition of the function PAR is not placed and maintained those defined by the user in previous graphics.
PAR	It accesses the function PAR that allows to modify many different aspects of the graph.
XLAB	Legend of the X axis in the scatter plot.
YLAB	Legend of the Y axis in the scatter plot.
COLOR	Color ramp to encode the number of counts within a pixel.
MTEXT	It allows to add text on the margins of the graph.
TEXT	It allows to add text in any area of the inner part of the graph.

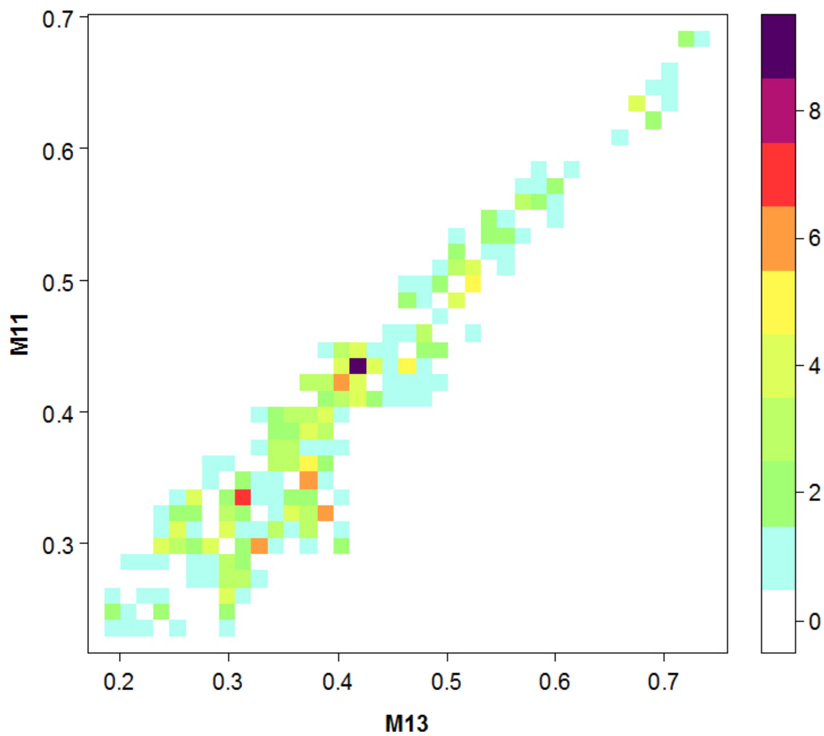
Details

FUNCTIONS

The scatter plot is performed with the function iplot of the package IDPmisc (Locher & Ruckstuhl, 2014). For further details see the help of the function iplot and/or Guisande & Vammonde (2012).

EXAMPLES

For the examples, morphometric data of several fish species of Characiforms are used. For details see Guisande et al. (2010). It is shown the relationship between M11 and M13 for all genera.



Value

A scatter plot is obtained, where the colors encode the density of the points in the scatter plot.

References

Guisande, C., Manjarrés-Hernández, A., Pelayo-Villamil, P., Granado-Lorencio, C., Riveiro, I., Acuña, A., Prieto-Piraquive, E., Janeiro, E., Matías, J.M., Patti, C., Patti, B., Mazzola, S., Jiménez, S., Duque, V. & Salmerón, F. (2010) IPez: An expert system for the taxonomic identification of fishes based on machine learning techniques. *Fisheries Research*, 102, 240-247.

Guisande, C. & Vaamonde, A. (2012) *Gráficos estadísticos y mapas con R*. Ediciones Díaz de Santos, Madrid, 367 pp.

Locher, R. & Ruckstuhl, A. (2014) Utilities of Institute of Data Analyses and Process Design. R package version 1.1.17. Available at: https://CRAN.R-project.org/package=IDPmisc.

Examples

```
## Not run:

data(Z1)

F64(data=Z1, varY="M11", varX="M13")

## End(Not run)
```

F65 *ROSE DIAGRAMS*

Description

It performs a wind rose diagram, although it may be depicted any other air-quality variable.

Usage

```
F65(data, winds, windd, var=NULL, date=NULL, year, month,
date.format="%d/%m/%Y %H:%M", type="default", ws.int=2, statistic="prop.count",
key.position="right", paddle=TRUE, annotate=TRUE, WROSE=NULL, PROSE=NULL,
COLOR="default", SUB=NULL, dec=",")
```

Arguments

`data`	Data file.
`winds`	Variable with the wind speed.
`windd`	Variable with the wind direction.
`var`	Any air-quality variable.
`date`	Variable with the date.
`year`	It is possible to select one or several years in a vector. It is necessary to specify the variable *date*.
`month`	It is possible to select one or several months in a vector. It is necessary to specify the variable *date*.

`date.format`	The format of date: "%d/%m/%Y %H:%M", "%d/%m/%Y", "%Y/%m/%d %H:%M" or "%Y/%m/%d".
`type`	It determines how the data are split: "year", "season", "month" "weekday" and so on. It is necessary to specify the variable *date*. It is also possible to choose type as another variable in the data frame. For further details see function windRose of the package openair (Carslaw, 2016).
`ws.int`	The wind speed interval.
`statistic`	The statistic to be applied to each data bin in the plot: "prop.count", "prop.mean" and "abs.count".
`key.position`	Location where the scale key is to plotted: "top", "right", "bottom" and "left".
`paddle`	If TRUE plots rose using 'paddle' style spokes. If FALSE plots rose using 'wedge' style spokes.
`annotate`	If TRUE then the percentage calm and mean values are printed in each panel together with a description of the statistic below the plot.
`WROSE`	It accesses the function windRose that allows to modify many different aspects of the wind rose diagram.
`PROSE`	It accesses the function pollutionRose that allows to modify many different aspects of the pollution rose diagram.
`COLOR`	Colours to be used for plotting. Options include "default", "increment", "heat", "jet", "hue" and user defined.
`SUB`	Legend of the subtitle in the rose diagram.
`dec`	It defines if the comma "," is used as decimal separator or the dot ".".

Details

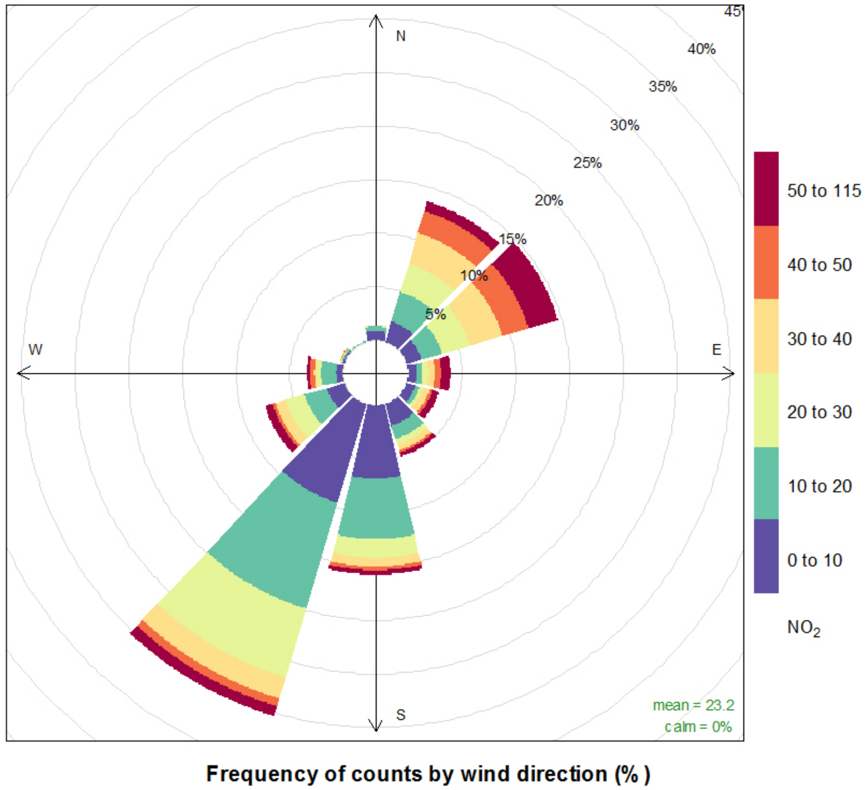
FUNCTIONS

The wind rose and pollution rose diagrams are performed with the function windRose of the package openair (Carslaw & Ropkins, 2012; 2016).

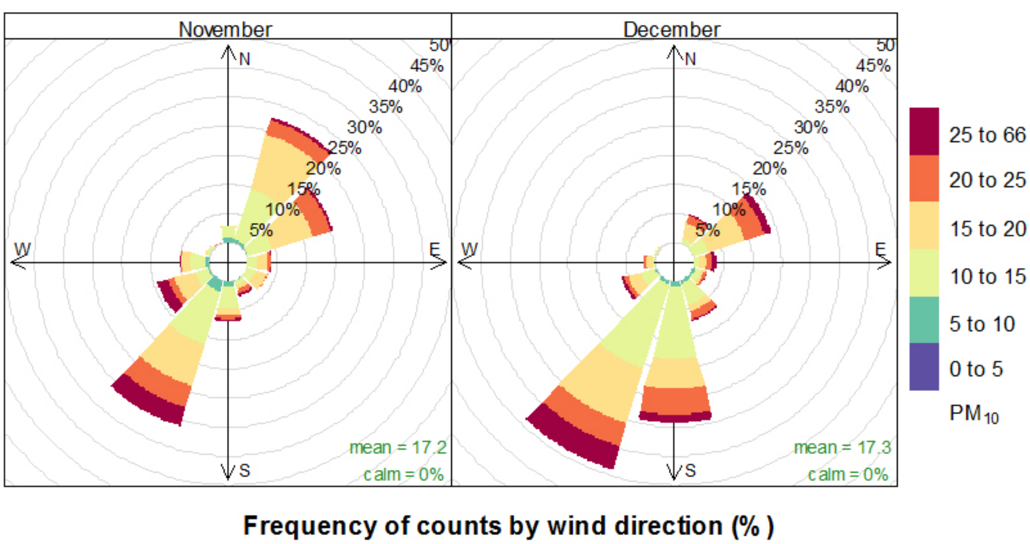
EXAMPLES

For the examples, hourly data of air pollutants, wind speed and wind direction in Santiago de Compostela (Spain) from 1/11/2015 to 31/12/2015 are used. The data were obtained from `https://www.meteogalicia.gal/web/index.action`.

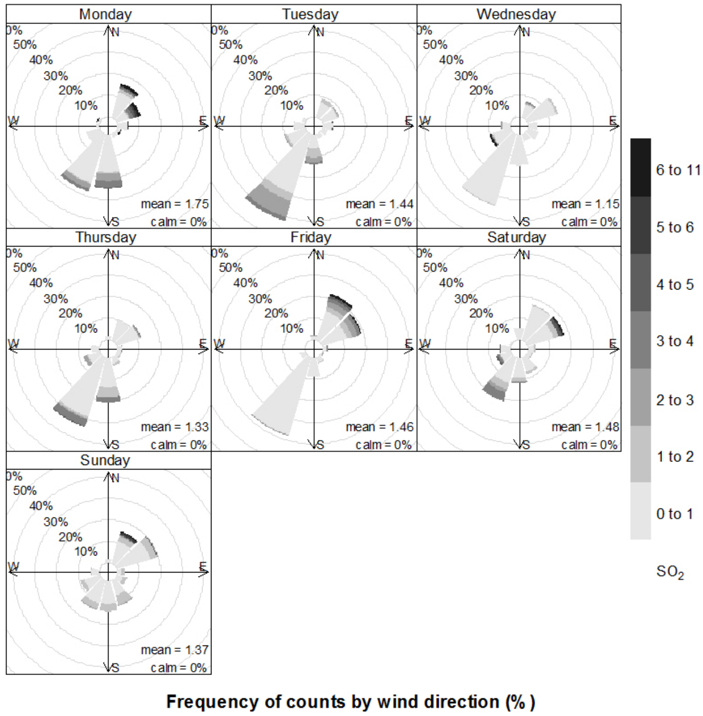
Example 1. Mean values of nitrogen dioxide for the all period.



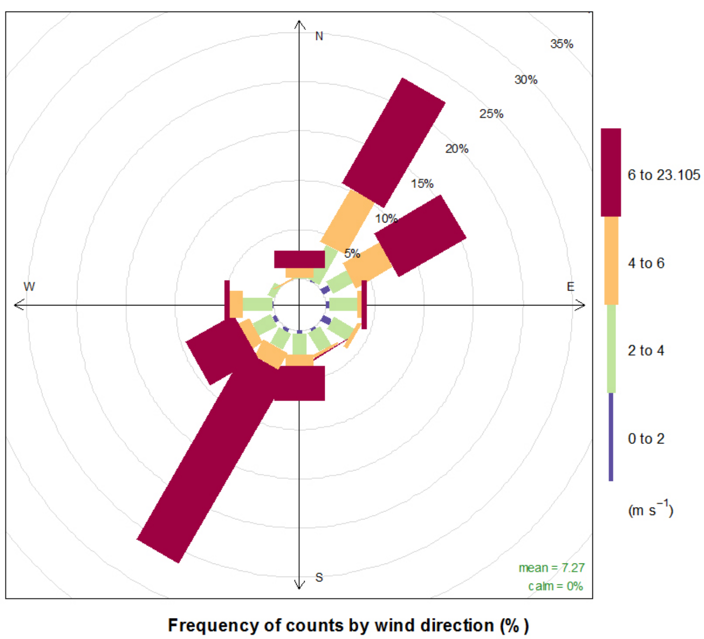
Example 2. Monthly means of particulate matter 10 micrometers or less in diameter. The language of the months is according to regional language settings of the control panel.



Example 3. Weekly means of sulfur dioxide in grey scale.



Example 4. Mean values of wind speed and direction in November. The argument *var=NULL*.



Value

A wind rose diagrams are obtained.

References

Carslaw, D. & Ropkins, K. (2012) openair - An R package for air quality data analysis. *Environmental Modelling & Software*, 27-28: 52-61. doi 10.1016/j.envsoft.2011.09.008. Carslaw, D. & Ropkins, K. (2016) Tools for the Analysis of Air Pollution Data. R package version 1.6.7. Available at: https://CRAN.R-project.org/package=openair.

Examples

```
## Not run:

#Example 1

data(Z22)

F65(data=Z22, winds="Ws", windd="Wd", var="NO2", paddle=FALSE)

#Example 2

F65(data=Z22, winds="Ws", windd="Wd", var="PM10", date="date", type="month", paddle=FALSE)

#Example 3

F65(data=Z22, winds="Ws", windd="Wd", var="SO2", date="date", type="weekday",
paddle=FALSE, COLOR="greyscale")

#Example 4

F65(data=Z22, winds="Ws", windd="Wd", date="date", month=11)

## End(Not run)
```

F66 *CALENDAR PLOT*

Description

It performs a calendar plot for time series data.

Usage

```
F66(data, date, var, winds=NULL, windd=NULL, year, month,
date.format="%d/%m/%Y %H:%M", annotate="date", key.position="right",
COLOR="heat", MAIN=NULL, CEX.LIM=c(0.6,1), BREAKS=FALSE, LABELS=NULL,
STATISTIC="mean", CALENDAR=NULL, dec=",")
```

Arguments

`data`	Data file.
`date`	Variable with the date.
`var`	Variable to be depicted.
`winds`	Variable with the wind speed.
`windd`	Variable with the wind direction.
`year`	It is possible to select one or several years in a vector.
`month`	It is possible to select one or several months in a vector.
`date.format`	The format of date: "%d/%m/%Y %H:%M", "%d/%m/%Y", "%Y/%m/%d %H:%M" or "%Y/%m/%d".
`annotate`	This option controls what appears on each day of the calendar. The option "date" shows day of the month; "wd" shows vector-averaged wind direction, "ws" shows vector-averaged wind direction scaled by wind speed and "value" which shows the daily mean value.
`key.position`	Location where the scale key is to plotted: "top", "right", "bottom" and "left".
`COLOR`	Colours to be used for plotting. Options include "default", "increment", "heat", "jet" and user defined.
`MAIN`	The main title of the plot.
`CEX.LIM`	For the annotation of concentration labels on each day. The first sets the size of the text below lim and the second sets the size of the text above lim.
`BREAKS`	If a categorical scale is required then these breaks will be used. If it is TRUE is calculated automatically but it may be defined by the user with a vector.
`LABELS`	If a categorical scale is required then these labels will be used. There is one less label than breaks. If it is TRUE is calculated automatically as "Very low", "Low", "Medium", "High" and "Very High", but it may be defined by user.
`STATISTIC`	The statistic to apply when aggregating the data. Can be one of "mean", "max", "min", "median", "frequency", "sd" or "percentile".
`CALENDAR`	It accesses the function calendarPlot that allows to modify many different aspects of the plot.
`dec`	It defines if the comma "," is used as decimal separator or the dot ".".

Details

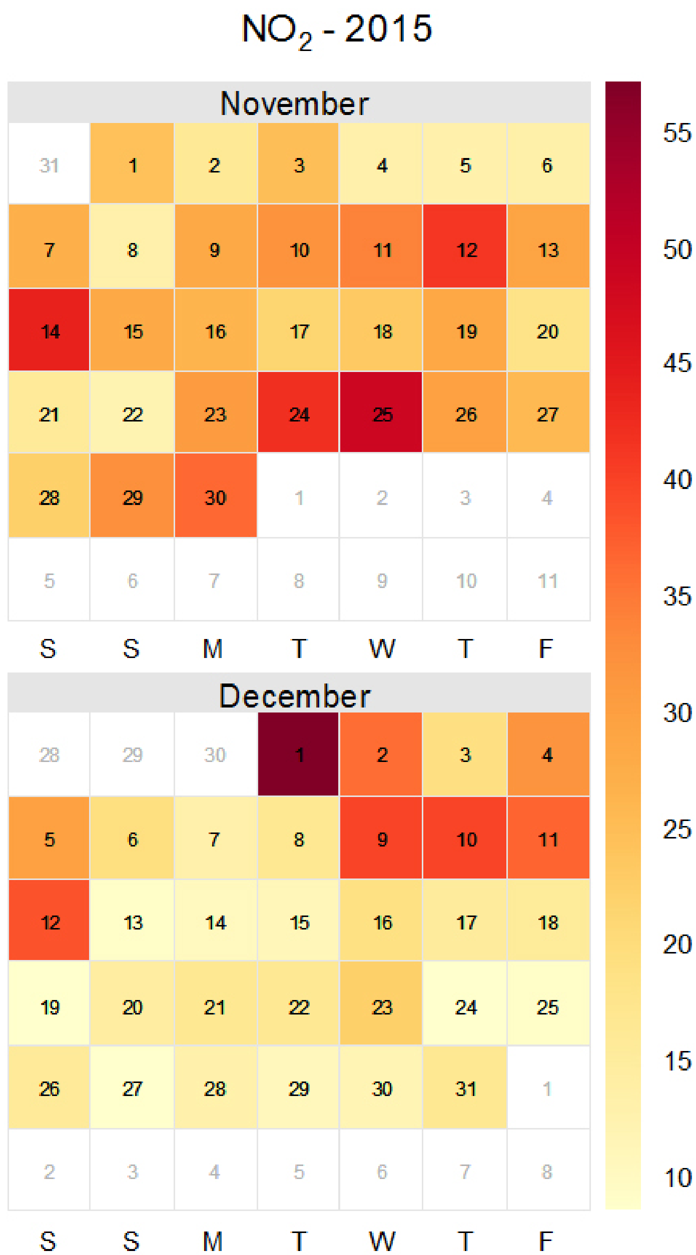
FUNCTIONS

The calendar plot is performed with the function calendarPlot of the package openair (Carslaw & Ropkins, 2012; 2016).

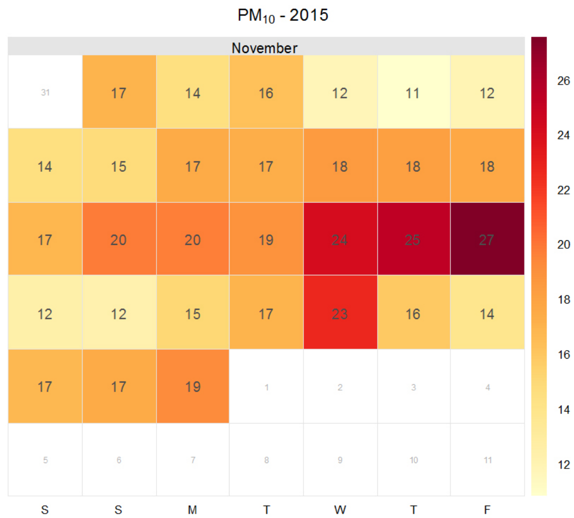
EXAMPLES

For the examples, hourly data of air pollutants, wind speed and wind direction in Santiago de Compostela (Spain) from 1/11/2015 to 31/12/2015 are used. The data were obtained from `https://www.meteogalicia.gal/web/index.action`.

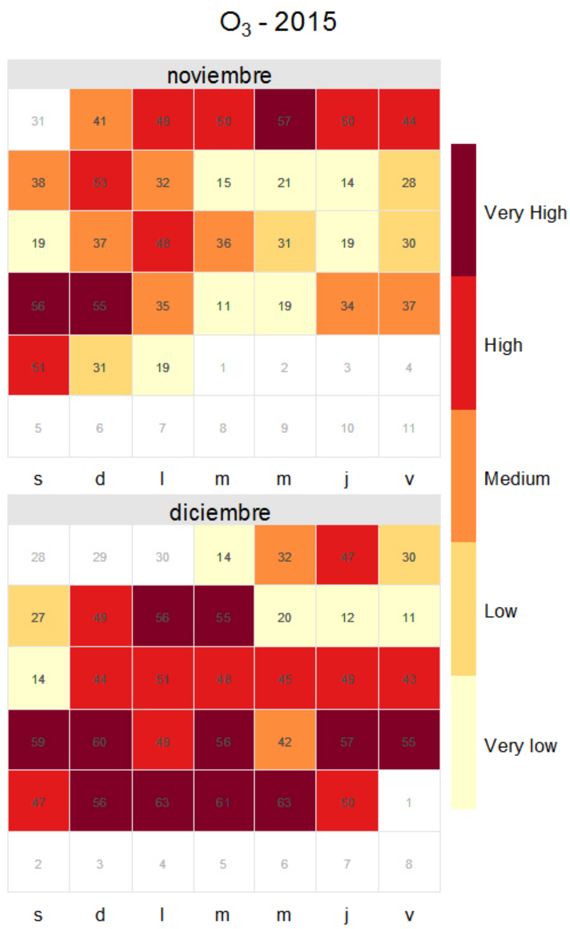
Example 1. Daily mean values of nitrogen dioxide for the all period.



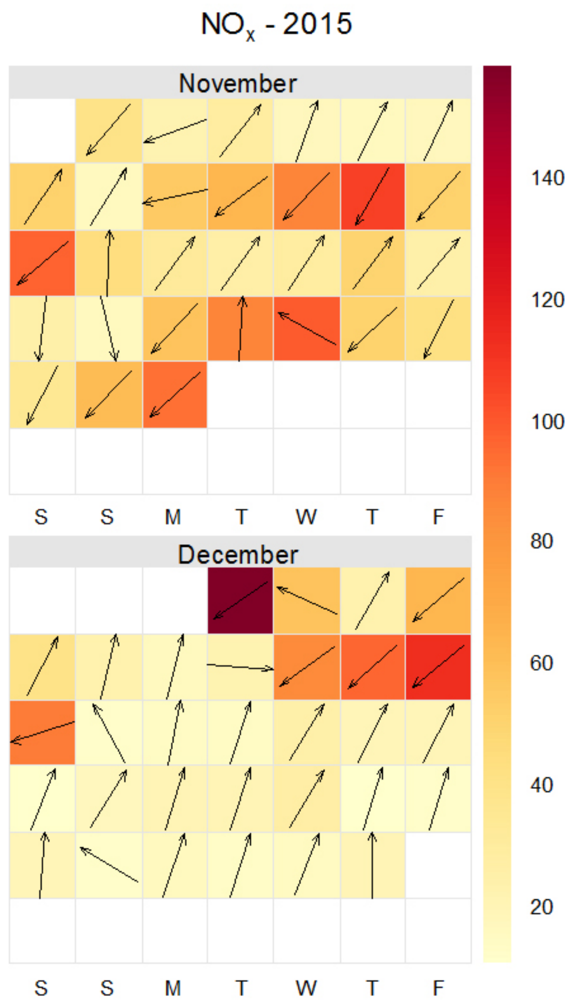
Example 2. Daily means of particulate matter 10 micrometers or less in diameter in November. The mean values are shown each day due to the argument *annotate="value"*.



Example 3. Daily means of ozone in categorical scale with the argument *BREAKS=TRUE*.



Example 4. Daily means of nitrogen oxides showing vector-averaged wind direction with the argument *annotate="wd"*.



Value

A calendar plot is depicted.

References

Carslaw, D. & Ropkins, K. (2012) openair - An R package for air quality data analysis. *Environmental Modelling & Software*, 27-28: 52-61. doi 10.1016/j.envsoft.2011.09.008. Carslaw, D. & Ropkins, K. (2016) Tools for the Analysis of Air Pollution Data. R package version 1.6.7. Available at: https://CRAN.R-project.org/package=openair.

Examples

```
## Not run:

#Example 1
```

```
data(Z22)

F66(data=Z22,  date="date", var="NO2")

#Example 2

F66(data=Z22, date="date", var="PM10",  month=11, annotate="value", CEX.LIM=c(1,1))

#Example 3

F66(data=Z22, date="date", var="O3", BREAKS=TRUE, annotate="value")

#Example 4

F66(data=Z22, date="date", var="NOX", wind="Wd", winds="Ws", annotate="wd")

## End(Not run)
```

F67 *TIME AVERAGE PLOTS*

Description

It performs a hourly, daily and monthly plots from time series data.

Usage

```
F67(data, date, var, year, month, date.format="%d/%m/%Y %H:%M",
tzone=NULL,normalise=FALSE, type = "default", difference=FALSE, name.pol=var,
SUB=NULL, XLAB=c("hour", "hour", "month", "weekday"), YLAB=NULL,
COLOR="hue", STATISTIC="mean", CI=TRUE, TIMEV=NULL, dec=",")
```

Arguments

`data`	Data file.
`date`	Variable with the date.
`var`	Variable(s) to be depicted.
`year`	It is possible to select one or several years in a vector.
`month`	It is possible to select one or several months in a vector.
`date.format`	The format of date: "%d/%m/%Y %H:%M", "%d/%m/%Y", "%Y/%m/%d %H:%M" or "%Y/%m/%d".
`tzone`	The time zone for the data. For further details see function timeVariation of the package openair (Carslaw, 2016).
`normalise`	If it is TRUE the variables are normalised.
`type`	It determines how the data are split: "default", "season", "year", "weekday" and so on.

`difference` If two variables are chosen then setting *difference=TRUE* will also plot the difference in means between the two variables. For further details see function timeVariation of the package openair (Carslaw, 2016).

`name.pol` Names to be given to the variable(s).

`SUB` Legend of the subtitle.

`XLAB` Legend of X axes, one for each sub-plot.

`YLAB` Legend of Y axes.

`COLOR` Colours to be used for plotting. Options include "hue", "default", "increment", "heat", "jet" and user defined.

`STATISTIC` The statistic to apply when aggregating the data: "mean" or "median".

`CI` If it is TRUE the confidence intervals are shown.

`TIMEV` It accesses the function timeVariation that allows to modify many different aspects of the plot.

`dec` It defines if the comma "," is used as decimal separator or the dot ".".

Details

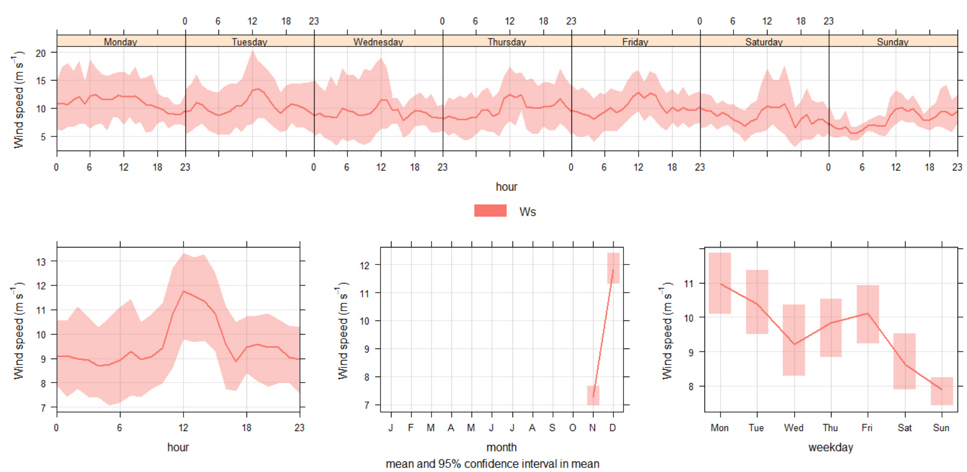
FUNCTIONS

The calendar plot is performed with the function timeVariation of the package openair (Carslaw & Ropkins, 2012; 2016).

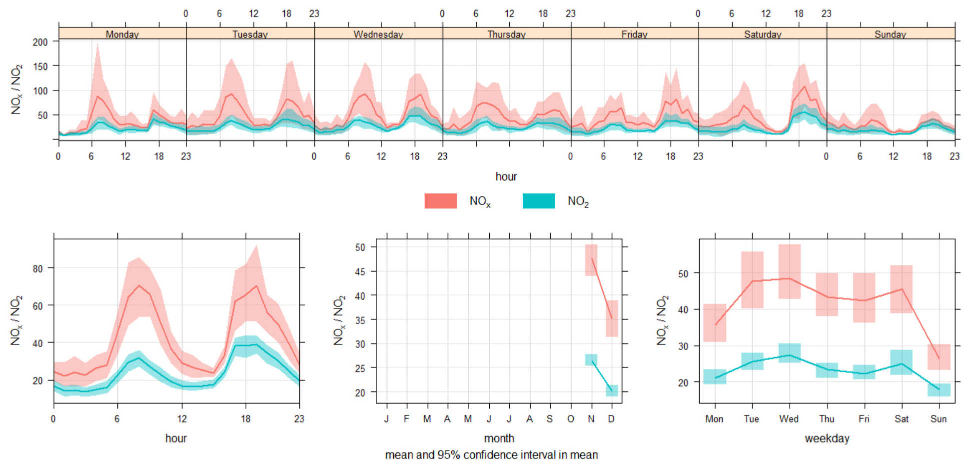
EXAMPLES

For the examples, hourly data of air pollutants, wind speed and wind direction in Santiago de Compostela (Spain) from 1/11/2015 to 31/12/2015 are used. The data were obtained from `https://www.meteogalicia.gal/web/index.action`.

Example 1. Hourly, daily and monthly means of wind speed.



Example 2. Hourly, daily and monthly means of nitrogen dioxide and nitrogen oxides.



Value

Hourly, daily and monthly plots are depicted.

References

Carslaw, D. & Ropkins, K. (2012) openair - An R package for air quality data analysis. *Environmental Modelling & Software*, 27-28: 52-61. doi 10.1016/j.envsoft.2011.09.008. Carslaw, D. & Ropkins, K. (2016) Tools for the Analysis of Air Pollution Data. R package version 1.6.7. Available at: https://CRAN.R-project.org/package=openair.

Examples

```
## Not run:

#Example 1

data(Z22)

F67(data=Z22, date="date", var="Ws", YLAB="Wind speed (m/s)")

#Example 2

F67(data=Z22, date="date", var=c("NOX","NO2"))

## End(Not run)
```

F68 *WALTER-LIETH DIAGRAM*

Description

It performs a Walter-Lieth diagram.

Usage

```
F68(data, date, Tmin, Tmax, Prec, year, date.format="%d/%m/%Y", est="",
alt=NA, per="", mlab="RLS", pcol="#005ac8", tcol="#e81800", pfcol="#79e6e8",
sfcol="#09a0d1", shem=FALSE, p3line=FALSE, mar=c(4,4,5,4), ResetPAR=TRUE, PAR=NULL,
file="Output.csv", na="NA", dec=",", row.names=TRUE)
```

Arguments

`data`	Data file. There are two options: 1) An 4x12 matrix, one column for each month, without NAs, where first row is monthly precipitation (mm), second row is monthly average maximum daily temperature (degrees C), third row is monthly average minimum daily temperature (degrees C) and forth row is monthly absolute minimum daily temperature (degrees C); 2) a data frame with the variables date, minimum temperature, maximum temperature and precipitation.
`date`	Variable with the date.
`Tmin`	Variable with the daily mean minimum temperature.
`Tmax`	Variable with the daily mean maximum temperature.
`Prec`	Variable with the daily total precipitation.
`year`	It is possible to select one or several years in a vector.
`date.format`	The format of date: "%d/%m/%Y %H:%M", "%d/%m/%Y", "%Y/%m/%d %H:%M" or "%Y/%m/%d".
`est`	Name of the weather station.
`alt`	Altitude of the weather station.
`per`	Period for which the averages have been computed.
`mlab`	If it is "RLS" the names of the months are those defined in the regional language settings of the computer. If it is "number" the number of the months are used.
`pcol`	Color for precipitation.
`tcol`	Color for temperature.
`pfcol`	Fill color for probable frosts.
`sfcol`	Fill color for sure frosts.
`shem`	Set to TRUE for southern hemisphere stations.
`p3line`	Set to TRUE to draw a suplementary precipitation line referenced to three times the temperature.
`mar`	A numeric vector with the format c(down, left, up, right) that defines the lines of the margins of the figure.
`ResetPAR`	If it is FALSE, the default condition of the function PAR is not placed and maintained those defined by the user in previous graphics.
`PAR`	It accesses the function PAR that allows to modify many different aspects of the graph.
`file`	Name of the CSV file with the estimation for each month of the monthly precipitation (mm), monthly average maximum daily temperature (degrees C), monthly average minimum daily temperature (degrees C) and monthly absolute minimum daily temperature (degrees C), if the data is not a 4x12 matrix.

`na`	CSV FILE. Text that is used in the cells without data.
`dec`	CSV FILE. It defines if the comma "," is used as decimal separator or the dot ".".
`row.names`	CSV FILE. Logical value that defines if identifiers are put in rows or a vector with a text for each of the rows.

Details

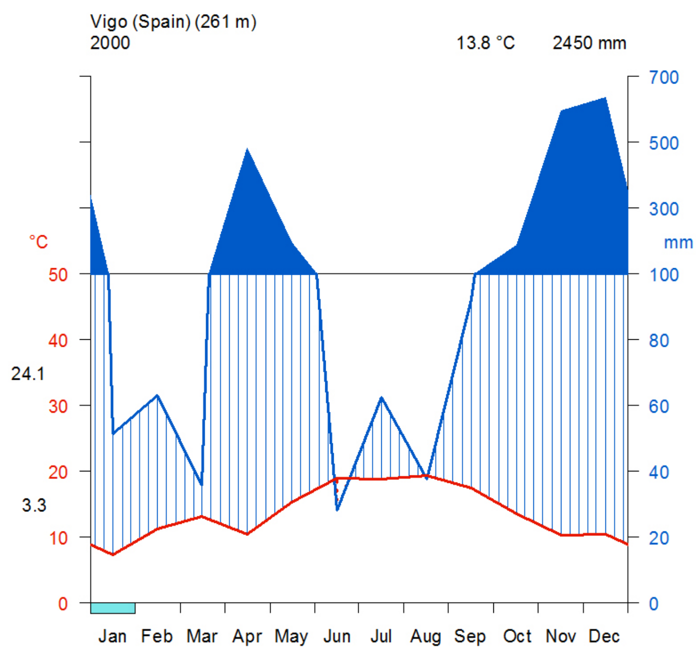
FUNCTIONS

The Walter-Lieth diagram is performed with the function climatol (Guijarro, 2103).

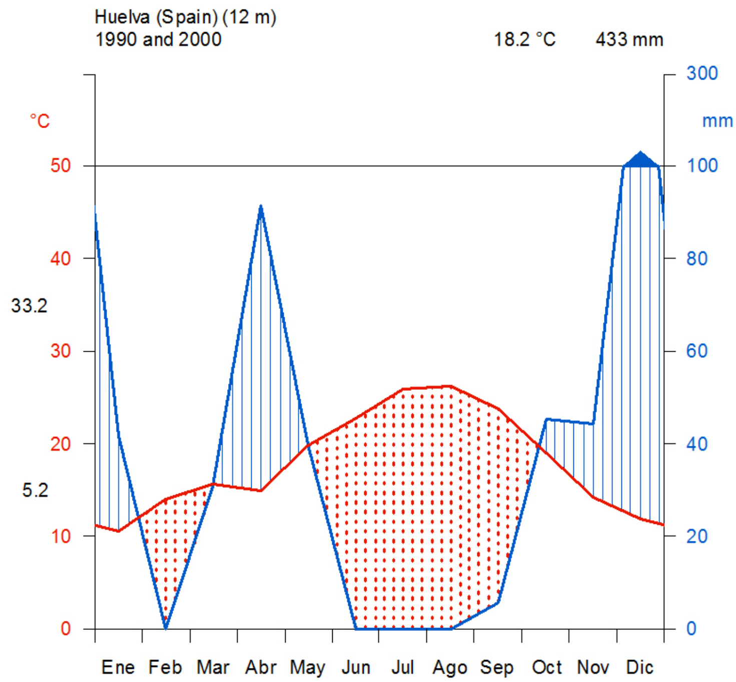
EXAMPLES

The data are maximum and minimum temperatures and precipitation in 1990 and 2000 in three cities in Spain: Huelva, Palma de Mallorca and Vigo (`https://www.aemet.es/es/portada`).

Example 1. An example using the format: date, minimum temperature, maximum temperature and precipitation. The plot shows the values in Vigo (Spain) in the year 2000.



Example 2. An example with the data format of an 4x12 matrix. The plot shows the values in Huelva (Spain) in the years 1990 and 2000.



Value

A Walter- Lieth diagram is depicted and if the data is not a 4x12 matrix, a CSV is saved with the monthly precipitation (mm), monthly average maximum daily temperature (degrees C), monthly average minimum daily temperature (degrees C) and monthly absolute minimum daily temperature (degrees C), one column for each month.

References

Guijarro, J.A. (2013) An R contributed package for homogenization of climatological series (and functions for drawing wind-rose and Walter&Lieth diagrams). R package version 2.2. Available at: https://cran.r-project.org/src/contrib/Archive/climatol/.

Examples

```
## Not run:

#Example 1

data(Z23)

data<-subset(Z23,(City == "Vigo"))

F68(data=data, date="date", Tmin="T.min", Tmax="T.max", Prec="Precipitation",
year=2000, est="Vigo (Spain)", alt=261, per="2000")

#Example 2
```

```
data(Z24)

F68(data=Z24, est="Huelva (Spain)", alt=12, per="1990 and 2000")

## End(Not run)
```

F69 *TIME PLOTS*

Description

It performs time series plots.

Usage

```
F69(data, date, var, year, month, date.format="%d/%m/%Y %H:%M",
avg.time ="default", group=FALSE,  smooth=TRUE, type = "default",
name.pol=var, SUB=NULL, MAIN=NULL, XLAB=NULL, YLAB=NULL, COLOR="brewer1",
STATISTIC=NULL, TIMEP=NULL, dec=",")
```

Arguments

`data`	Data file.
`date`	Variable with the date.
`var`	Variable(s) to be depicted.
`year`	It is possible to select one or several years in a vector.
`month`	It is possible to select one or several months in a vector.
`date.format`	The format of date: "%d/%m/%Y %H:%M", "%d/%m/%Y", "%Y/%m/%d %H:%M" or "%Y/%m/%d".
`avg.time`	This defines the time period to average to: "default", "sec", "min", "hour", "day", "DSTday", "week", "month", "2 month", "quarter", "year" and so on. For further details see function timePlot of the package openair (Carslaw, 2016).
`group`	It is FALSE, if more than one variable is chosen, they are plotted in separate panels with their own scaled. If it is TRUE, then they are plotted on the same plot with the same scale.
`smooth`	If it is TRUE a smooth line is applied to the data.
`type`	It determines how the data are split: "default", "weekday", "month", "season", "year" and so on.
`name.pol`	Names to be given to the variable(s).
`SUB`	Legend of the subtitle.
`MAIN`	Main title.
`XLAB`	Legend of X axis.
`YLAB`	Legend of Y axis.

`COLOR`	Colours to be used for plotting.
`STATISTIC`	The statistic to apply when aggregating the data: NULL, "mean", "max", "min", "median", "frequency", "sd", or "percentile". For further details see function timePlot of the package openair (Carslaw, 2016).
`TIMEP`	It accesses the function timePlot that allows to modify many different aspects of the plot.
`dec`	It defines if the comma "," is used as decimal separator or the dot ".".

Details

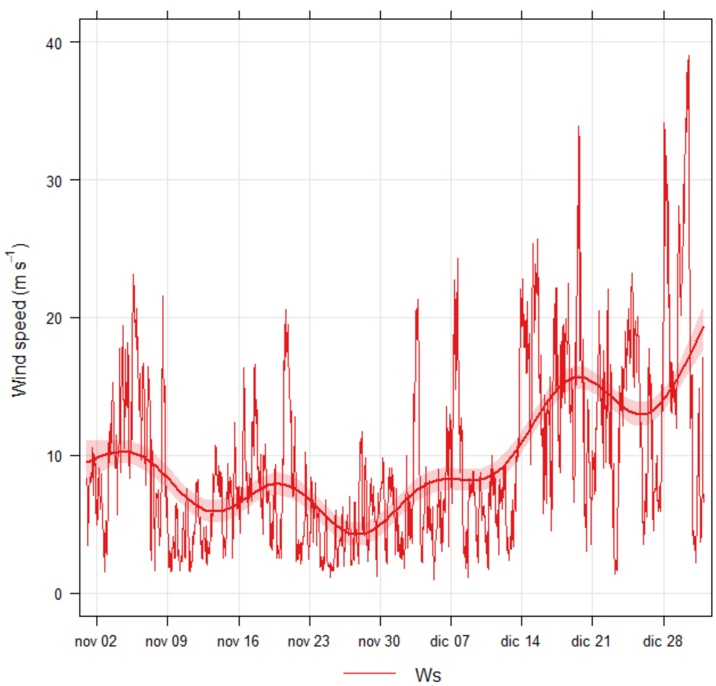
FUNCTIONS

The plot is performed with the function timePlot of the package openair (Carslaw & Ropkins, 2012; 2016).

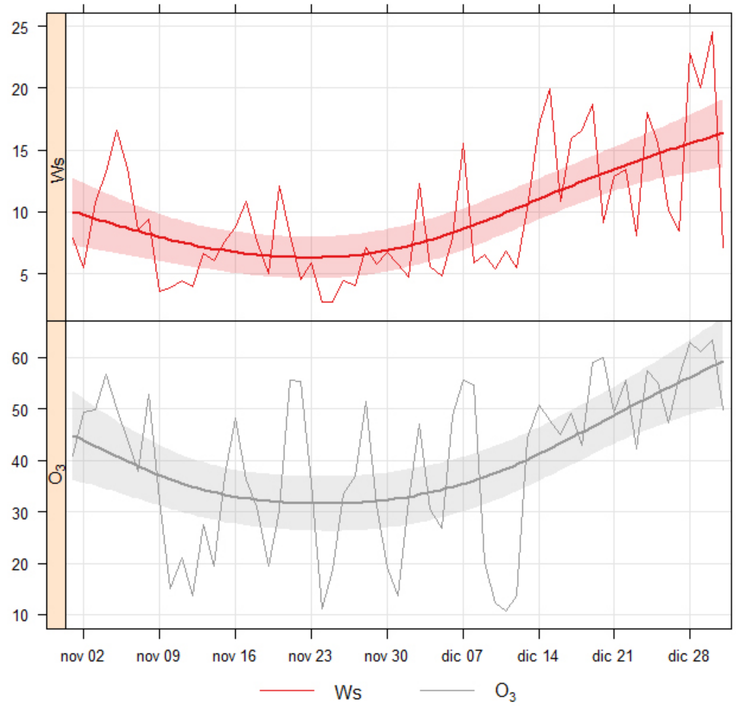
EXAMPLES

For the examples, hourly data of air pollutants, wind speed and wind direction in Santiago de Compostela (Spain) from 1/11/2015 to 31/12/2015 are used. The data were obtained from `https://www.meteogalicia.gal/web/index.action`.

Example 1. Hourly wind speed.



Example 2. Daily means of wind speed and ozone.



Value

Time series plots are depicted.

References

Carslaw, D. & Ropkins, K. (2012) openair - An R package for air quality data analysis. *Environmental Modelling & Software*, 27-28: 52-61. doi 10.1016/j.envsoft.2011.09.008. Carslaw, D. & Ropkins, K. (2016) Tools for the Analysis of Air Pollution Data. R package version 1.6.7. Available at: https://CRAN.R-project.org/package=openair.

Examples

```
## Not run:

#Example 1

data(Z22)

F69(data=Z22, date="date", var="Ws", YLAB="Wind speed (m/s)")

#Example 2

F69(data=Z22, date="date", var=c("Ws","O3"), avg.time="day")

## End(Not run)
```

F70 *TIME PLOTS*

Description

It performs interactive time series plots with the function plot_ly of the package plotly (Sievert et al., 2016). For further details see https://plotly.com/r/reference/ and https://github.com/plotly/plotly.R.

Usage

```
F70(data, date, var, symbolvar=NULL, colorvar=NULL, year, month, avg.time="day",
date.format="%d/%m/%Y %H:%M", ticks=10, symbols=NULL, colors=NULL, mode="lines",
TRACE=FALSE, LEGEND=FALSE, MAIN=NULL, XLAB=NULL, YLAB=NULL,
XFONT=list(family = "Courier New, monospace", size=24,  color = "black"),
YFONT=list(family="Courier New, monospace", size=24, color="black"),
marker=list(size=10), yaxis=list(title=ylab, titlefont=YFONT),
xaxis=list(title=xlab, autotick=TRUE, dtick=dtick, titlefont=XFONT),
line=list(color=colors, dash="solid"), traceline=list(color=colors,
dash="dash"), dec=",")
```

Arguments

`data`	Data file.
`date`	Variable with the date.
`var`	Variable to be depicted in the Y axis.
`symbolvar`	Optionally a variable name or a (discrete) vector to use for symbol encoding.
`colorvar`	Optionally a variable name or a vector to use for color mapping.
`year`	It is possible to select one or several years in a vector.
`month`	It is possible to select one or several months in a vector.
`avg.time`	This defines the time period to average to: "hour", "day", "DSTday", "week", "month", "2 month", "quarter", "year" and so on. For further details see function timePlot of the package openair (Carslaw, 2016).
`date.format`	The format of date: "%d/%m/%Y %H:%M", "%d/%m/%Y", "%Y/%m/%d %H:%M" or "%Y/%m/%d".
`ticks`	Number of ticks in the axes.
`symbols`	A character vector of symbol types. Possible values: "dot", "cross", "diamond", "square", "triangle-down", "triangle-left", "triangle-right" or "triangle-up".
`colors`	Either a colorbrewer2.org palette name (e.g. "YlOrRd" or "Blues"), or a vector of colors to interpolate in hexadecimal "#RRGGBB" format, or a color interpolation function like colorRamp.
`mode`	It determines the drawing mode of the plot: "lines", "markers", "lines+markers", "lines+markers+text", "markers+text", "lines+text" or "none"

`TRACE`	If it is TRUE a trace is added.
`LEGEND`	It it is TRUE the legend is shown.
`MAIN`	Main title of the plot.
`XLAB`	Legend of X axis.
`YLAB`	Legend of Y axis.
`XFONT`	Font of X axis.
`YFONT`	Font of Y axis.
`marker`	It defines the format of the symbols.
`yaxis`	It defines the format of Y axis.
`xaxis`	It defines the format of X axis.
`line`	It defines the format of the line connecting the points.
`traceline`	It defines the format of the trace line.
`dec`	It defines if the comma "," is used as decimal separator or the dot ".".

Details

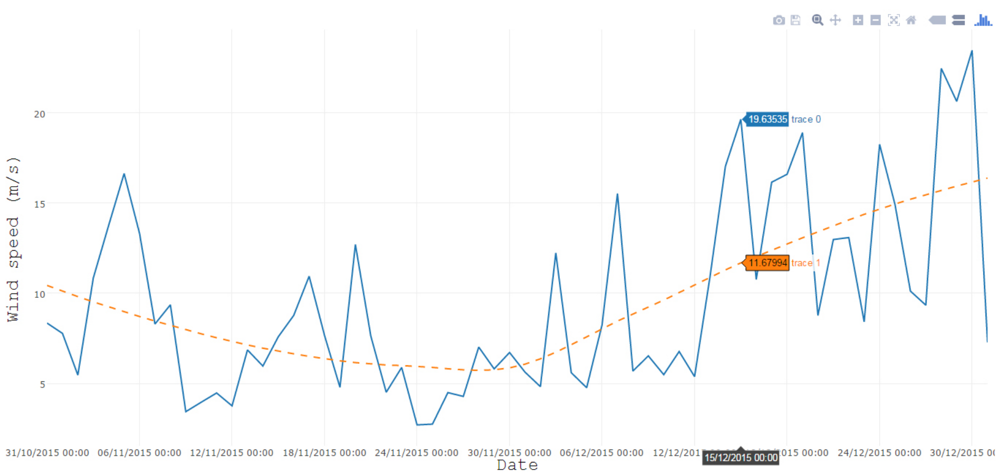
FUNCTIONS

The plot is performed with the function plot_ly of the package plotly (Sievert et al., 2016).

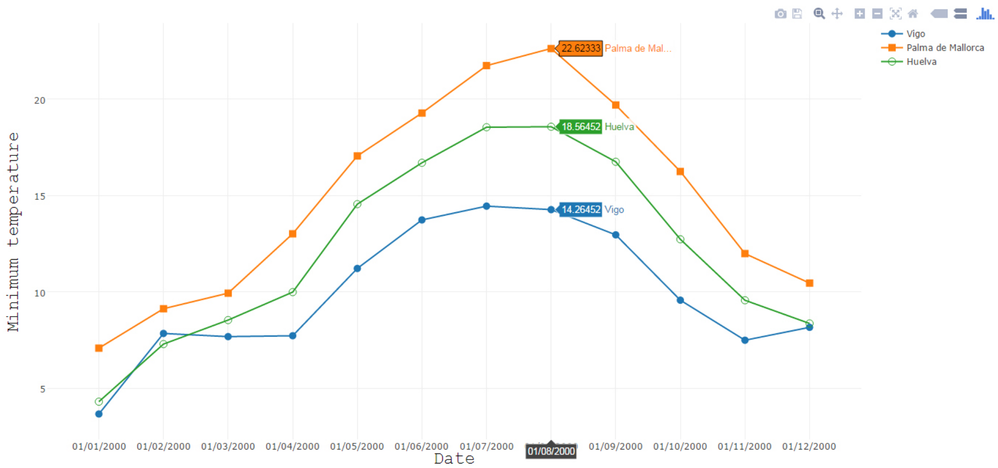
EXAMPLES

For the example 1, hourly data of air pollutants, wind speed and wind direction in Santiago de Compostela (Spain) from 1/11/2015 to 31/12/2015 are used. The data were obtained from `https://www.meteogalicia.gal/web/index.action`. For the examples 2 and 3, the data are maximum and minimum temperatures and precipitation in 1990 and 2000 in three cities in Spain: Huelva, Palma de Mallorca and Vigo (`https://www.aemet.es/es/portada`).

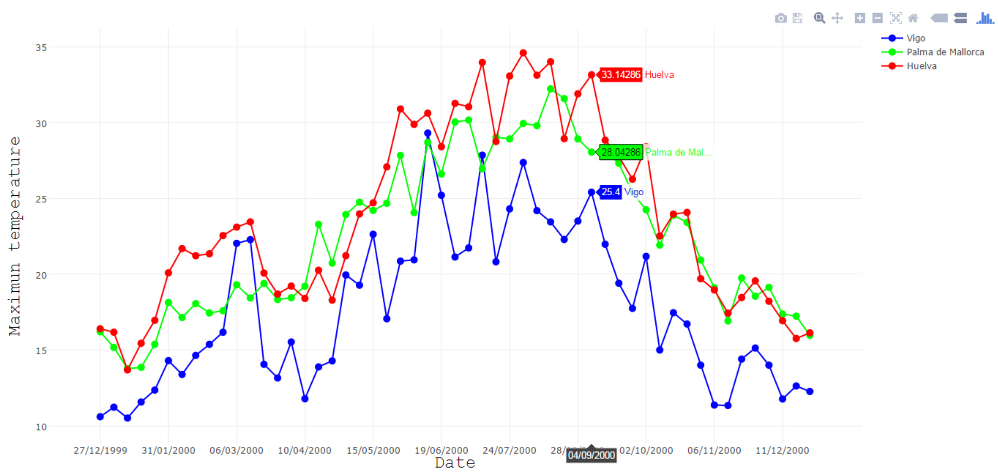
Example 1. Without groups. Daily means of wind speed.



Example 2. With groups. Monthly means of minimum temperature in three cities of Spain. The symbols of the cities are specified with the argument *symbolvar="City"* and the symbols may be optionally modified with the argument *symbols*.



Example 3. With groups. Weekly means of maximum temperature in three cities of Spain. The colors are specified with the argument *colorvar="City"* and the colors may be optionally modified with the argument *colors*.



Value

Interactive time series plots are depicted.

References

Sievert, C., Parmer, C., Hocking, T., Chamberlain, S., Ram, K., Corvellec, M. & Despouy, P. (2016) Create Interactive Web Graphics via Plotly's JavaScript Graphing Library. R package version 2.0.16. Available at: https://CRAN.R-project.org/package=plotly.

Examples

```
## Not run:
```

```
#Example 1. Without groups

data(Z22)

F70(data=Z22, date="date", var="Ws", TRACE=TRUE, YLAB="Wind speed (m/s)")

#Example 2. With groups

data(Z23)

F70(data=Z23, date="date", var="T.min", symbolvar="City", avg.time="month",
symbols=c("dot","square","circle-open"), date.format="
year=2000, mode="lines+markers", YLAB="Minimum temperature")

#Example 3. With groups

data(Z23)

F70(data=Z23, date="date", var="T.max", colorvar="City", avg.time="week",
date.format="
YLAB="Maximun temperature")

## End(Not run)
```

F71 *3D LEVEL PLOT*

Description

A 3D level plot is depicted.

Usage

```
F71(data, X, Y,  Z, SURFACE=NULL, axes=FALSE, AXES=NULL,
MTEXT=NULL, TITLE=NULL, XLAB="", YLAB="", ZLAB="", MAIN=NULL,
SUB=NULL, LINE=NA, COL=NULL, COLT="black", FONT=2, CEX=1.5)
```

Arguments

`data`	Data file.
`X`	Variable X.
`Y`	Variable Y.
`Z`	Variable Z.
`SURFACE`	It accesses the function rgl.surface that allows to modify many different aspects of the 3d plot.
`axes`	If TRUE the axes are displayed.

AXES	It accesses the function axes3d that allows to modify the axes.
MTEXT	It accesses the function mtext3d that allows to add text outside the plot.
TITLE	It accesses the function title3d that allows to modify the text the plot.
XLAB	Legend of the X axis.
YLAB	Legend of the Y axis.
ZLAB	Legend of the Z axis.
MAIN	Main title of the 3d plot.
SUB	Subtitle of the 3d plot.
LINE	The line of the plot margin to draw the label on.
COL	Gradient color.
COLT	Color of the text.
FONT	Font of the text.
CEX	Size of the text.

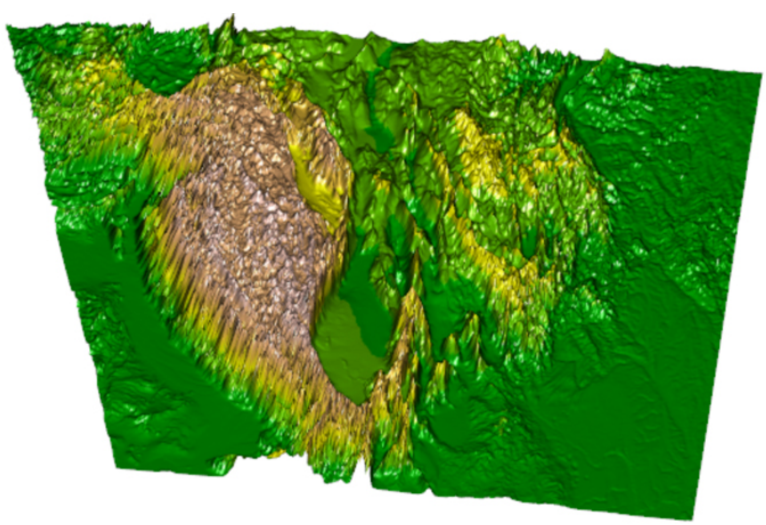
Details

FUNCTIONS

The plot is performed with the functions mtext3d, , axes3d, , open3d, rgl.surface and title3d of the package rgl (Adler et al., 2017).

EXAMPLES

Altitude in the Himalayan region, with the altitude (variable Z) in a matrix format.



Value

A 3D surface plot is depicted.

References

Adler, D., Murdoch, D. et al. (2017) 3D Visualization Using OpenGL. R package version 0.98.1. Available at: https://CRAN.R-project.org/package=rgl.

Examples

```
## Not run:

#Including the variable Z as a matrix

data(Z10)
m<-as.matrix(Z10[,c(-1,-2)])
F71(data=Z10,  X="Longitude", Y="Latitude",  Z=m)

#Including only a matrix

data(volcano)
F71(data=volcano)

#Identifying the variable Z

data(Z10)

F71(data=Z10, X="Latitude", Y="Longitude", Z=c("Z1","Z2","Z3", "Z4","Z5","Z6",
"Z7","Z8","Z9","Z10","Z11","Z12","Z13","Z14","Z15","Z16","Z17","Z18","Z19","Z20",
"Z21","Z22","Z23","Z24","Z25","Z26","Z27","Z28","Z29","Z30","Z31","Z32","Z33",
"Z34","Z35","Z36","Z37","Z38","Z39","Z40","Z41","Z42","Z43","Z44","Z45","Z46",
"Z47","Z48","Z49","Z50","Z51","Z52","Z53","Z54","Z55","Z56","Z57","Z58","Z59",
"Z60","Z61","Z62","Z63","Z64","Z65","Z66","Z67","Z68","Z69","Z70","Z71","Z72",
"Z73","Z74","Z75","Z76","Z77","Z78","Z79","Z80","Z81","Z82","Z83","Z84","Z85",
"Z86","Z87","Z88","Z89","Z90","Z91","Z92","Z93","Z94","Z95","Z96","Z97","Z98",
"Z99","Z100","Z101","Z102","Z103","Z104","Z105","Z106","Z107","Z108","Z109",
"Z110","Z111","Z112","Z113","Z114","Z115","Z116","Z117","Z118","Z119","Z120",
"Z121","Z122","Z123","Z124","Z125","Z126","Z127","Z128","Z129","Z130","Z131",
"Z132","Z133","Z134","Z135","Z136","Z137","Z138","Z139","Z140","Z141","Z142",
"Z143","Z144","Z145","Z146","Z147","Z148","Z149","Z150","Z151","Z152","Z153",
"Z154","Z155","Z156","Z157","Z158","Z159","Z160","Z161","Z162","Z163","Z164",
"Z165","Z166","Z167","Z168","Z169","Z170","Z171","Z172","Z173","Z174","Z175",
"Z176","Z177","Z178","Z179","Z180","Z181","Z182","Z183","Z184","Z185","Z186",
"Z187","Z188","Z189","Z190","Z191","Z192","Z193","Z194","Z195","Z196","Z197",
"Z198","Z199","Z200","Z201","Z202","Z203","Z204","Z205","Z206","Z207","Z208",
"Z209","Z210","Z211","Z212","Z213","Z214","Z215","Z216","Z217","Z218","Z219",
"Z220","Z221","Z222","Z223","Z224","Z225","Z226","Z227","Z228","Z229","Z230",
"Z231","Z232","Z233","Z234","Z235","Z236","Z237","Z238","Z239","Z240","Z241",
"Z242","Z243","Z244","Z245","Z246","Z247","Z248","Z249","Z250","Z251","Z252",
"Z253","Z254","Z255","Z256","Z257","Z258","Z259","Z260","Z261","Z262","Z263",
"Z264","Z265","Z266","Z267","Z268","Z269","Z270","Z271","Z272","Z273","Z274",
"Z275","Z276","Z277","Z278","Z279","Z280","Z281","Z282","Z283","Z284","Z285",
"Z286","Z287","Z288","Z289","Z290","Z291","Z292","Z293","Z294","Z295","Z296",
"Z297","Z298","Z299","Z300","Z301","Z302","Z303","Z304","Z305","Z306","Z307",
"Z308","Z309","Z310","Z311","Z312","Z313","Z314","Z315","Z316","Z317","Z318",
"Z319","Z320","Z321","Z322","Z323","Z324","Z325","Z326","Z327","Z328","Z329",
```

```
"Z330","Z331","Z332","Z333","Z334","Z335","Z336","Z337","Z338","Z339","Z340",
"Z341","Z342","Z343","Z344","Z345","Z346","Z347","Z348","Z349","Z350","Z351",
"Z352","Z353","Z354","Z355","Z356","Z357","Z358","Z359","Z360","Z361","Z362",
"Z363","Z364","Z365","Z366","Z367","Z368","Z369","Z370","Z371","Z372","Z373",
"Z374","Z375","Z376","Z377","Z378","Z379","Z380","Z381","Z382","Z383","Z384",
"Z385","Z386","Z387","Z388","Z389","Z390","Z391","Z392","Z393","Z394","Z395",
"Z396","Z397","Z398","Z399","Z400","Z401","Z402","Z403","Z404","Z405","Z406",
"Z407","Z408","Z409","Z410","Z411","Z412","Z413","Z414","Z415","Z416","Z417",
"Z418","Z419","Z420","Z421","Z422","Z423","Z424","Z425","Z426","Z427","Z428",
"Z429","Z430","Z431","Z432","Z433","Z434","Z435","Z436","Z437","Z438","Z439",
"Z440","Z441","Z442","Z443","Z444","Z445","Z446","Z447","Z448","Z449","Z450",
"Z451","Z452","Z453","Z454","Z455","Z456","Z457","Z458","Z459","Z460","Z461",
"Z462","Z463","Z464","Z465","Z466","Z467","Z468","Z469","Z470","Z471","Z472",
"Z473","Z474","Z475","Z476","Z477","Z478","Z479","Z480","Z481"))

## End(Not run)
```

F72 *2D CONTOUR PLOT*

Description

A 2D contour plot is depicted.

Usage

```
F72(data, X, Y, Z, CONTOUR=NULL, XLAB=NULL, YLAB=NULL, ZLAB=NULL, COL="blue",
ResetPAR=TRUE, PAR=NULL, MTEXT=NULL, TEXT=NULL)
```

Arguments

data	Data file.
X	Variable X.
Y	Variable Y.
Z	Variable Z.
CONTOUR	It accesses the function contour that allows to modify many different aspects of the 2d plot.
XLAB	Legend of the X axis.
YLAB	Legend of the Y axis.
ZLAB	Legend of the Z axis.
COL	Color of the lines.
ResetPAR	If it is FALSE, the default condition of the function PAR is not placed and maintained those defined by the user in previous graphics.
PAR	It accesses the function PAR that allows to modify many different aspects of the graph.
MTEXT	It allows to add text on the margins of the graph.
TEXT	It allows to add text in any area of the inner part of the graph.

Details

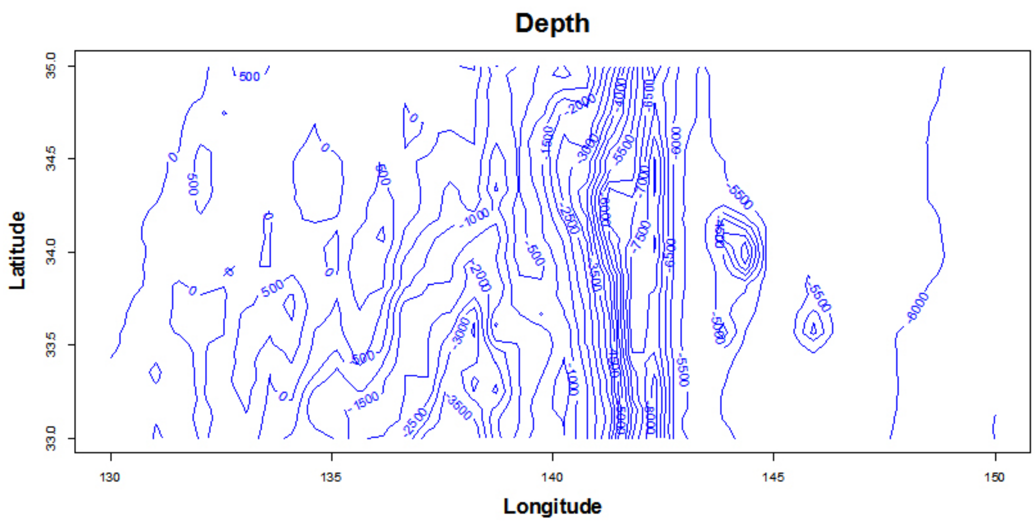
FUNCTIONS

The plot is performed with the functions contour of the base package graphics. The matrix is obtained using the function interp of the package akima (Akima et al., 2015). For further details see Guisande & Vammonde (2012).

EXAMPLES

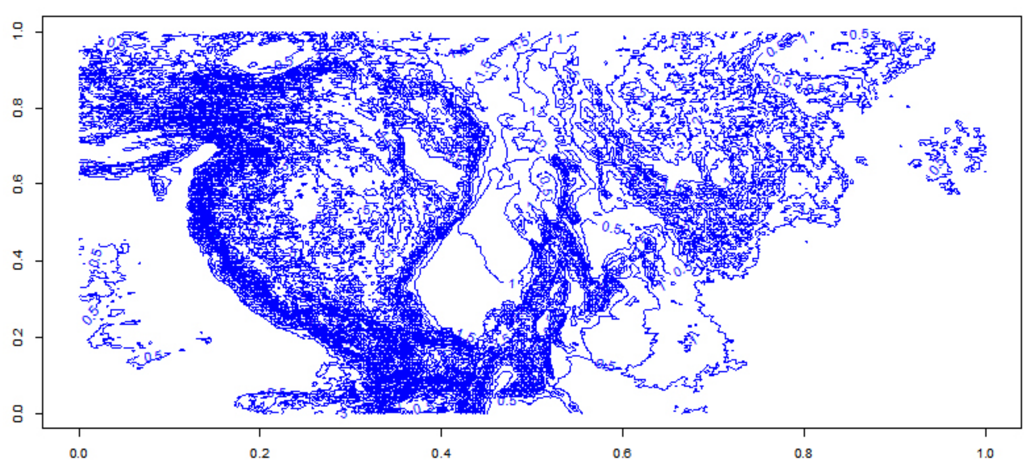
Example 1.

Depth in a coastal area close to Japan, with the depth (variable Z) in a column format.



Example 2.

Altitude in the Himalayan region, with the altitude (variable Z) in a matrix format.



Value

A 2D contour plot is depicted.

References

Akima, H., Gebhardt, A., Petzoldt, T & Maechler, M. (2016) Interpolation of irregularly spaced data. R package version 0.6-2. Available at: https://CRAN.R-project.org/package=akima.

Guisande, C. & Vaamonde, A. (2012) Gráficos estadísticos y mapas con R. Ediciones Díaz de Santos, Madrid, 367 pp.

Examples

```
## Not run:

#Example 1. With data format not as matrix

data(Z11)
F72(data=Z11,  X="Longitude", Y="Latitude", Z="Depth")

#Example 2. With data format as matrix

data(Z10)
m<-as.matrix(Z10[,c(-1,-2)])
F72(data=m)


## End(Not run)
```

F73 *2D LEVEL PLOT*

Description

A 2D level plot is depicted.

Usage

```
F73(data, X, Y, Z, IMAGE=NULL, XLAB=NULL, YLAB=NULL, ZLAB=NULL,
COL=rev(heat.colors(100)), ResetPAR=TRUE, PAR=NULL, MTEXT= NULL, TEXT=NULL)
```

Arguments

data	Data file.
X	Variable X.
Y	Variable Y.
Z	Variable Z.

IMAGE	It accesses the function image2D that allows to modify many different aspects of the 2D plot.
XLAB	Legend of the X axis.
YLAB	Legend of the Y axis.
ZLAB	Legend of the Z axis.
COL	Color palette to be used for the image function or for the contours.
ResetPAR	If it is FALSE, the default condition of the function PAR is not placed and maintained those defined by the user in previous graphics.
PAR	It accesses the function PAR that allows to modify many different aspects of the graph.
MTEXT	It allows to add text on the margins of the graph.
TEXT	It allows to add text in any area of the inner part of the graph.

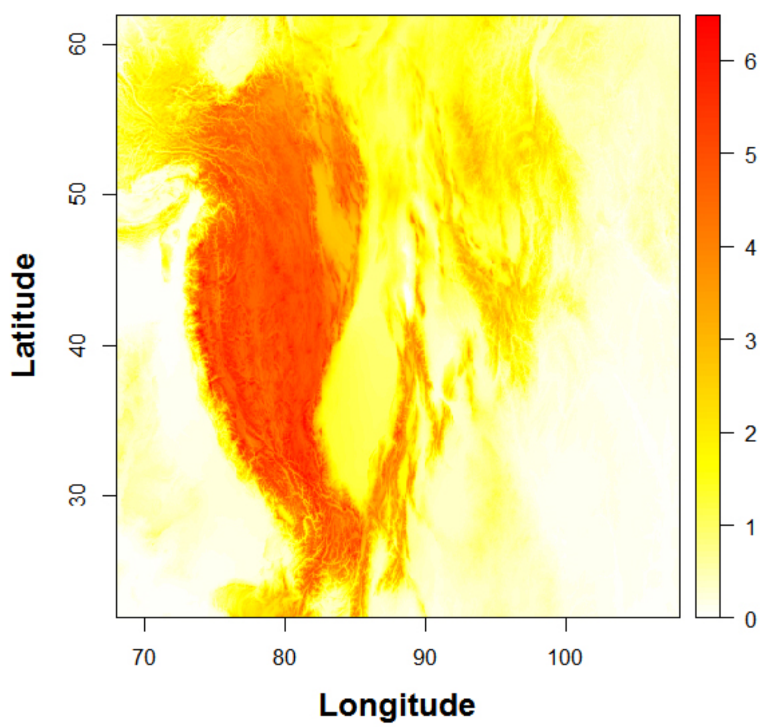
Details

FUNCTIONS

The plot is performed with the functions image2D of package plot3D (Soetaert, 2016). The matrix is obtained using the function interp of the package akima (Akima et al., 2015). For further details see Guisande & Vammonde (2012).

EXAMPLES

Altitude in the Himalayan region



Value

A 2D level plot is depicted.

References

Akima, H., Gebhardt, A., Petzoldt, T & Maechler, M. (2016) Interpolation of irregularly spaced data. R package version 0.6-2. Available at: https://CRAN.R-project.org/package=akima.

Guisande, C. & Vaamonde, A. (2012) Gráficos estadísticos y mapas con R. Ediciones Díaz de Santos, Madrid, 367 pp.

Soetaert, K. (2016) Plotting Multi-Dimensional Data. R package version 1.1. Available at: https://CRAN.R-project.org/package=plot3D.

Examples

```
## Not run:

#Including the variable Z as a matrix

data(Z10)
m<-as.matrix(Z10[,c(-1,-2)])
F73(data=Z10,  X="Longitude", Y="Latitude",  Z=m)

#Including only a matrix

data(Z10)
m<-as.matrix(Z10[,c(-1,-2)])
F73(data=m)

#With data format not as matrix

data(Z11)
F73(data=Z11,  X="Longitude", Y="Latitude", Z="Depth")

## End(Not run)
```

F74 *2D AND 3D LEVEL INTERACTIVE PLOTS*

Description

2D AND 3D level interactive plotS are depicted.

Usage

```
F74(data, X, Y, Z, type="contour", COLORS=NULL, XLAB=NULL,
YLAB=NULL, ZLAB=NULL, MAIN=NULL,
XFONT=list(family="Courier New, monospace", size=24, color="black"),
YFONT=list(family="Courier New, monospace", size=24, color="black"),
yaxis=list(title=ylab, titlefont=YFONT),
xaxis=list(title=xlab, autotick=TRUE, titlefont=XFONT))
```

Arguments

`data`	Data file.
`X`	Variable X.
`Y`	Variable Y.
`Z`	Variable Z.
`type`	Type of the plot: "contour" for 2D level plot and "surface" for 3D level plot.
`COLORS`	Color palette to be used for the image function or for the contours.
`XLAB`	Legend of the X axis.
`YLAB`	Legend of the Y axis.
`ZLAB`	Legend of the Z axis.
`MAIN`	Main title of the plot.
`XFONT`	Font of X axis.
`YFONT`	Font of Y axis.
`yaxis`	It defines the format of Y axis.
`xaxis`	It defines the format of X axis.

Details

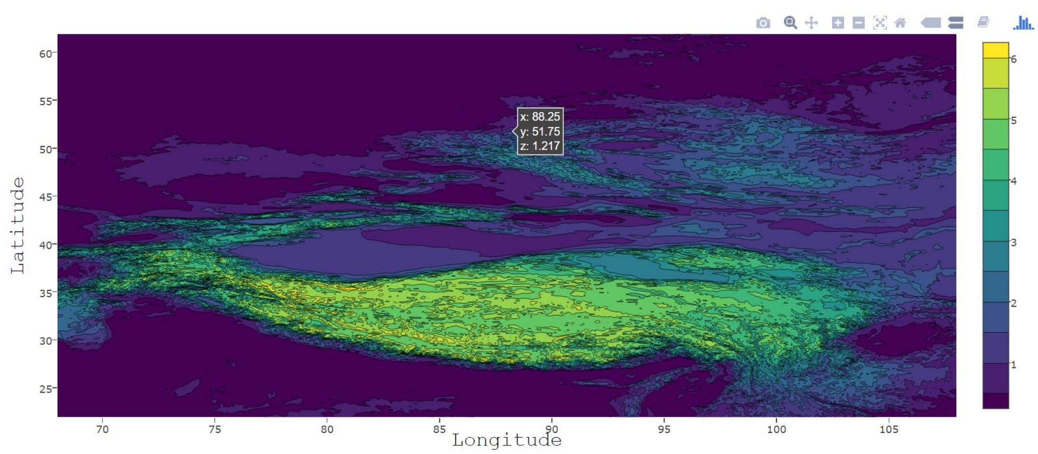
FUNCTIONS

The plot is performed with the function plot_ly of the package plotly (Sievert et al., 2016).

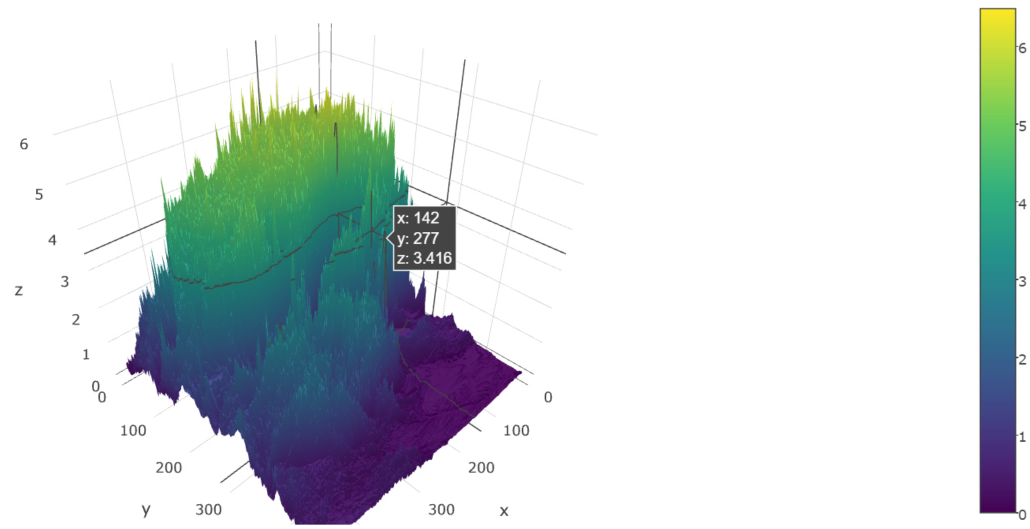
EXAMPLES

Altitude in the Himalayan region

2D level plot



3D level plot



Value

A 2D level and 3D level interactive plots are depicted.

References

Sievert, C., Parmer, C., Hocking, T., Chamberlain, S., Ram, K., Corvellec, M. & Despouy, P. (2016) Create Interactive Web Graphics via 'plotly.js'. R package version 4.5.6. Available at: https://CRAN.R-project.org/package=plotly.

Examples

```
## Not run:

#Example 1. 2D Level plot

#Including the variable Z as a matrix

data(Z10)
m<-as.matrix(Z10[,c(-1,-2)])
F74(data=Z10,  X="Longitude", Y="Latitude",  Z=m)

#Including only a matrix

data(Z10)
m<-as.matrix(Z10[,c(-1,-2)])
F74(data=m)

#Example 2. 3D surface plot

data(Z10)
m<-as.matrix(Z10[,c(-1,-2)])
F74(data=m, type="surface")
```

```
## End(Not run)
```

F75 *RASTER MAP*

Description

Enables mapping of administrative areas with high resolution and raster maps of variables (species richness, environmental variables, biogeographic indexes, etc.) using CSV files or rater files, with a spatial resolution (cell size) specified in the file.

Usage

```
F75(data, Area="World", minLon, maxLon, minLat, maxLat, colbg="#FFFFFF",
colcon="#C8C8C8", colf="black", pro=TRUE, inc=0.005, exclude=NULL,
colexc=NULL, colfexc="black", colscale=rev(heat.colors(100)), legend.pos="y",
breaks=10, xl=0, xr=0, yb=0, yt=0, asp, lab=NULL, xlab="Longitude",
ylab="Latitude", main=NULL, cex.main=1.2, cex.lab=1, cex.axis=0.9,
cex.legend=0.9, family="sans", font.main=2, font.lab=1, font.axis=1,
lwdP=0.6, lwdC=0.1, trans=c(1,1), log=c(0,0), ndigits=0, ini=NULL,
end=NULL, jpg=FALSE, filejpg="Map.jpg")
```

Arguments

data	A matrix (see details section) or an ESRI ASCII raster file with the environmental variable, data of richness, etc.
Area	Only if using RWizard (http://www.ipez.es/RWizard/). A character with the name of the administrative area or a vector with several administrative areas (countries, regions, etc.) or river basins. If it is "World" (default) the entire world is plotted. For using administrative areas or river basins, in addition to use RWizard, it is also necessary to replace data(world) by @_Build_AdWorld_ (see example 2).
minLon, maxLon	Optionally it is possible to define the minimum and maximum longitude.
minLat, maxLat	Optionally it is possible to define the minimum and maximum latitude.
colbg	Background color of the map (in some cases this is the sea).
colcon	Background color of the administrative areas.
colf	Color of administrative areas border.
pro	If it is TRUE an automatic calculation is made in order to correct the aspect ratio y/x along latitude.
inc	Adds some room along the map margins with the limits x and y thus not exactly the limits of the selected areas.
exclude	A character with the name of the administrative area or a vector with several administrative areas that may be plotted with a different color on the map (only if using RWizard).

`colexc`	Background color of areas selected in the argument exclude.
`colfexc`	Color of borders of the areas selected in the argument exclude.
`colscale`	Palette color.
`legend.pos`	Whether to have a horizontal "x" or vertical "y" color scale.
`breaks`	Number of breakpoints of the color legend.
`xl,xr,yb,yt`	The lower left and upper right coordinates of the color legend in user coordinates.
`asp`	The y/x aspect ratio.
`lab`	A numerical vector of the form c(x, y) which modifies the default way that axes are annotated. The values of x and y give the (approximate) number of tickmarks on the x and y axes.
`xlab`	A title for the X axis.
`ylab`	A title for the Y axis.
`main`	An overall title for the plot.
`cex.main`	The magnification to be used for main titles relative to the current setting of cex.
`cex.lab`	The magnification to be used for X and Y labels relative to the current setting of cex.
`cex.axis`	The magnification to be used for axis annotation relative to the current setting of cex.
`cex.legend`	The magnification to be used for the color scale relative to the current setting of cex.
`family`	The name of a font family for drawing text.
`font.main`	The font to be used for plot main titles.
`font.lab`	The font to be used for x and y labels.
`font.axis`	The font to be used for axis annotation.
`lwdP`	Line width of the plot.
`lwdC`	Line width of the borders.
`trans`	It is possible to multiply or divide the dataset by a value. For a vector with two values, the first may be 0 (divide) or 1 (multiply), and the second number is the value of the division or multiplication.
`log`	It is possible to apply a logarithmic transformation to the dataset. For a vector with two values, the first may be 0 (do not log transform) or 1 (log transformation), and the second number is the value to be added in case of log transformation.
`ndigits`	Number of decimals in legend of the color scale.
`ini`	Minimum to be considered in the color scale.
`end`	Maximum to be considered in the color scale.
`jpg`	If TRUE the plots are exported to jpg files instead of using the windows device.
`filejpg`	Name of the jpg file.

Details

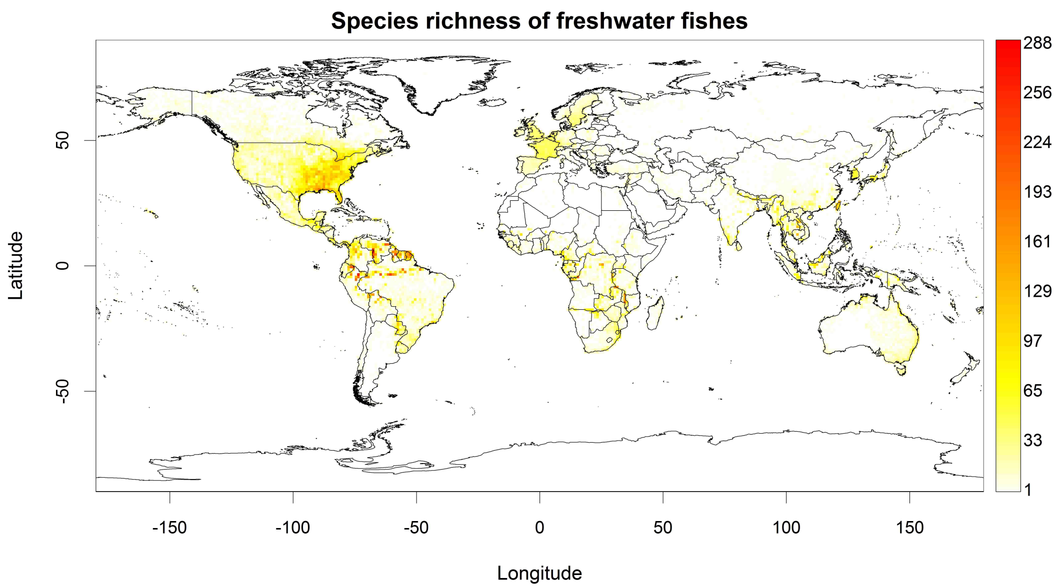
The matrix required in the argument *data* may be obtained using ModestR, which is available at the web site https://www.modestr.es/sweb/: Export/Export checked maps/To RWizard Applications/To MapsR. It is also possible to use an ESRI ASCII raster file.

FUNCTIONS

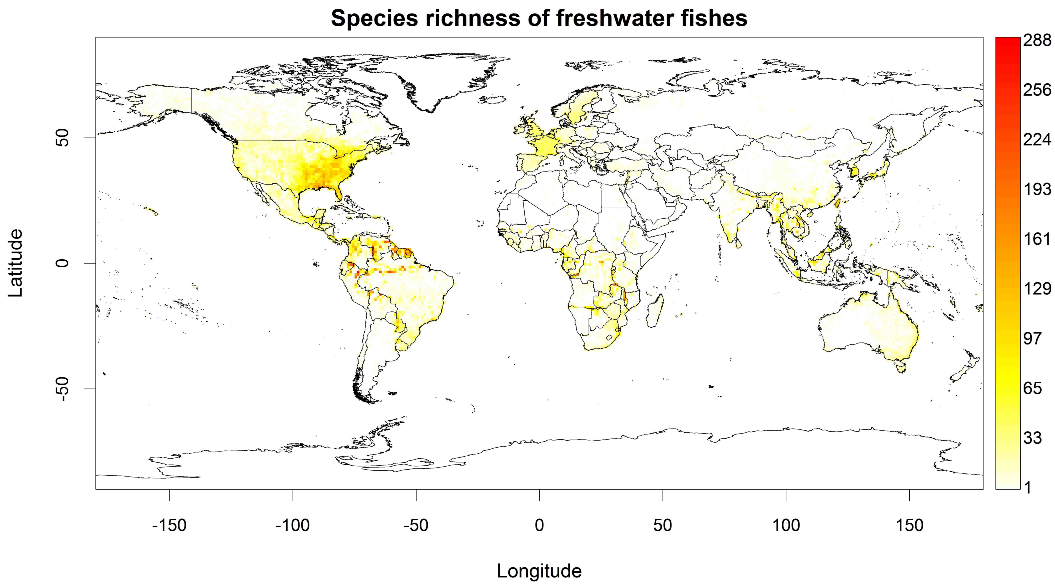
The function color.legend of the package plotrix (Lemon et al., 2014) is used for building the map.

EXAMPLE

Example 1. An ESRI ASCII raster file with the information of species richness of freshwater fishes around the world.



Example 2. Selection of some countries.



Value

A map is obtained.

References

Lemon, J. (2006) Plotrix: a package in the red light district of R. *R-News*, 6(4):8-12.

Lemon, J., Bolker, B., Oom, S., Klein, E., Rowlingson, B., Wickham, H., Tyagi, A., Eterradossi, O., Grothendieck, G., Toews, M., Kane, J., Turner, R., Witthoft, C., Stander, J., Petzoldt, T., Duursma, R., Biancotto, E., Levy, O., Dutang, C., Solymos, P., Engelmann, R., Hecker, M., Steinbeck, F., Borchers, H., Singmann, H., Toal, T. & Ogle, D. (2015). Various plotting functions. R package version 3.6-1. Available at: https://CRAN.R-project.org/package=plotrix.

Examples

```
## Not run:
#Example 1.

data(Z25)
data(adworld)
F75(data=Z25, main= "Species richness of freshwater fishes", jpg=TRUE)

#Example 2.

####Only with RWizard
data(Z25)
@_Build_AdWorld_
F75(data = Z25 , Area = c("Argentina", "Bolivia", "Brazil", "Chile", "Colombia",
"Ecuador", "French Guiana", "Guyana", "Paraguay", "Peru", "Suriname",
"Uruguay", "Venezuela","Panama","Nicaragua","Costa Rica"),
main = "Species richness of freshwater fishes in South America", jpg=TRUE)
```

```
## End(Not run)
```

F76 *SHAPES OF RIVER BASINS AND ADMINISTRATE AREAS OF RWIZARD*

Description

Enables mapping of shapes and also, shapes of administrative areas and river basins available into RWizard.

Usage

```
F76(Area="World", minLon, maxLon, minLat, maxLat, colbg="#FFFFFF",
colcon="#C8C8C8", colf="black", pro = TRUE, boxf = "plot", inc = 0.005,
exclude=NULL, colexc=NULL, colfexc="black", axes=TRUE, asp, lab= NULL,
xlab="Longitude", ylab="Latitude", main=NULL, cex.main=1.6, cex.lab=1.4,
cex.axis=1.2, family="sans", font.main=2, font.lab=1, font.axis=1,
jpg=TRUE, filejpg="Map.jpg")
```

Arguments

`Area`	A character with the name of the administrative area or a vector with several administrative areas (see details).
`minLon, maxLon`	Optionally it is possible to define the minimum and maximum longitude (see details).
`minLat, maxLat`	Optionally it is possible to define the minimum and maximum latitude (see details).
`colbg`	Background color of the map (in some cases is the sea).
`colcon`	Background color of the administrative areas.
`colf`	Color of administrative areas border.
`pro`	If it is TRUE an automatic calculation is made in order to correct the aspect ratio y/x along latitude.
`boxf`	Draws a box around the current plot: "plot", "figure", "inner", "outer" or "n" (without box).
`inc`	Add some room on the margins of the map and, therefore, the limits x and y are not exactly the limits of the selected areas.
`exclude`	A character with the name of the administrative area or a vector with several administrative areas that may be plotted with a different color in the map.
`colexc`	Background color of areas selected in the argument exclude.
`colfexc`	Color of borders of the areas selected in the argument exclude.
`axes`	If FALSE does not draw the axes.
`asp`	The y/x aspect ratio.

`lab`	A numerical vector of the form c(x, y) which modifies the default way that axes are annotated. The values of x and y give the (approximate) number of tickmarks on the x and y axes.
`xlab`	A title for the x axis.
`ylab`	A title for the y axis.
`main`	An overall title for the plot.
`cex.main`	The magnification to be used for main titles relative to the current setting of cex.
`cex.lab`	The magnification to be used for x and y labels relative to the current setting of cex.
`cex.axis`	The magnification to be used for axis annotation relative to the current setting of cex.
`family`	The name of a font family for drawing text.
`font.main`	The font to be used for plot main titles.
`font.lab`	The font to be used for x and y labels.
`font.axis`	The font to be used for axis annotation.
`jpg`	If TRUE the plots are exported to jpg files instead of using the windows device.
`filejpg`	Name of the jpg file.

Details

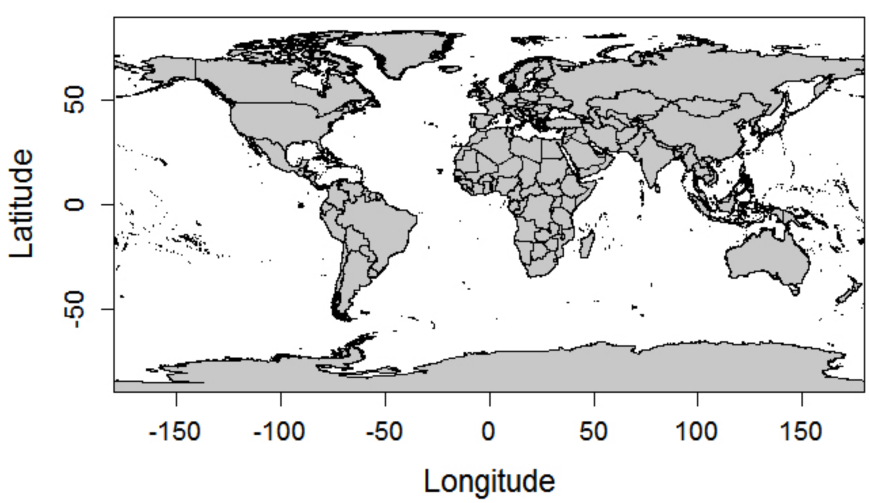
FUNCTIONS

The function image and the function color.legend of the package plotrix (Lemon et al., 2014) are used for building the map.

EXAMPLES

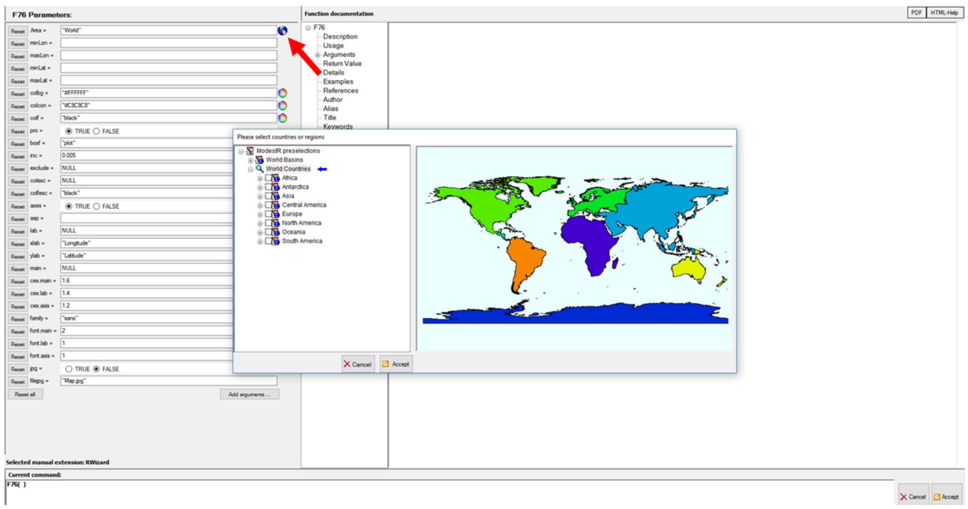
Example 1

If the argument *Area* = *"World"* (default) the entire world is plotted.

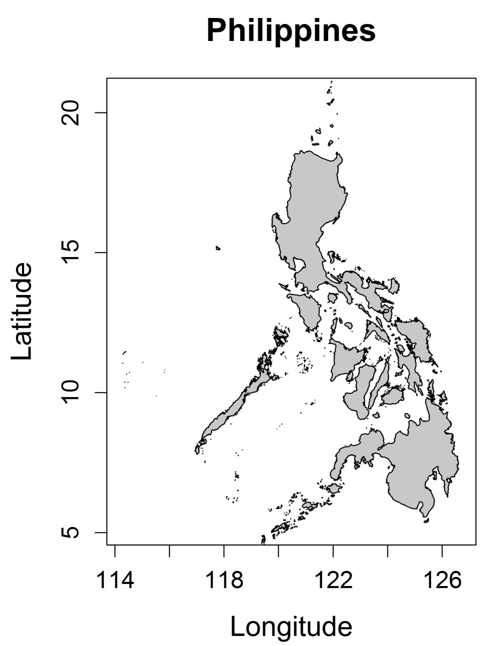


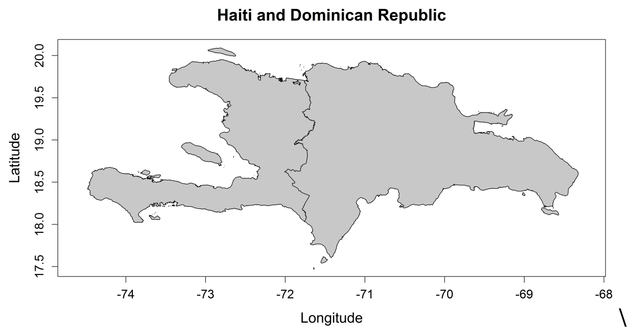
Example 2

Clicking on the icon world, as it is shown in the following screenshot (red arrow), would display a menu with all countries and their regions.



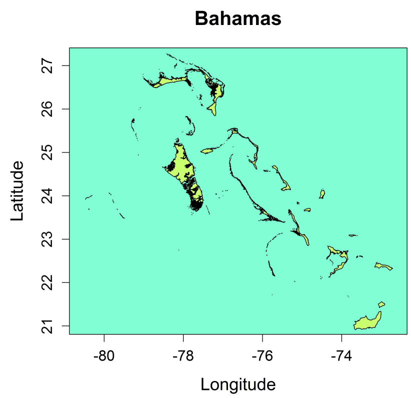
It is possible to select one or several countries and/or regions and the selected administrative areas would be only shown in the map. For instance the following maps show Philippines, Haiti and Dominican Republic.





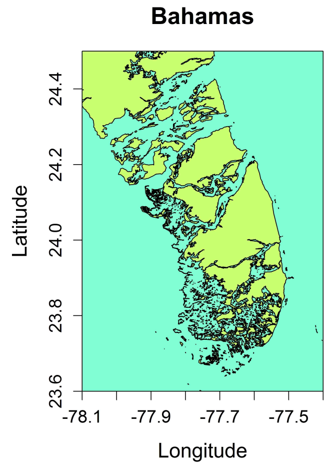
Example 3

It is also possible to change the background color.



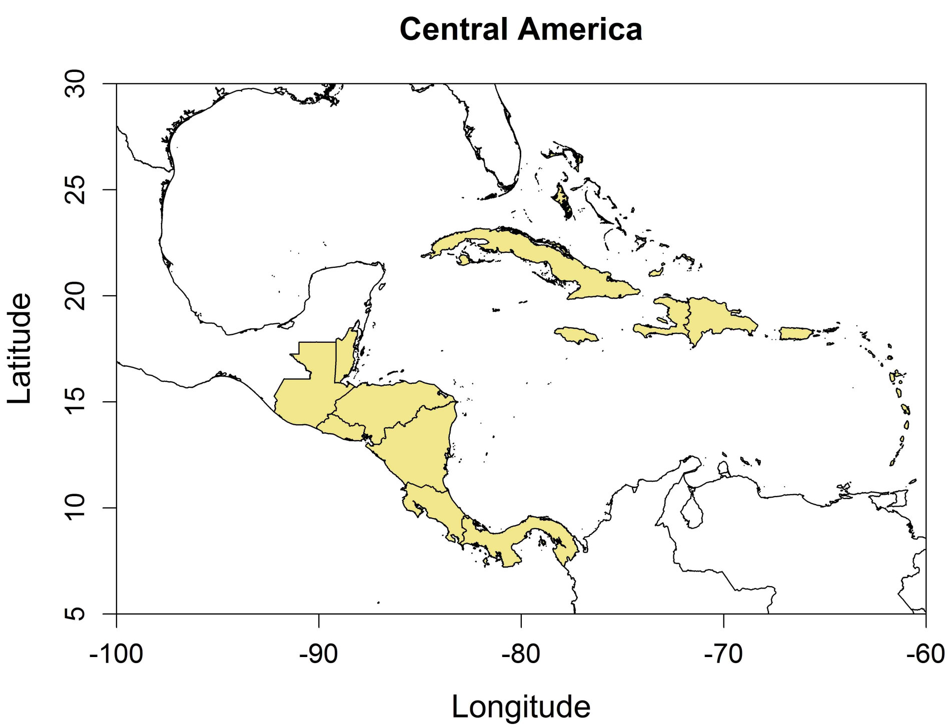
Example 4

If the arguments *minLon*, *maxLon*, *minLat* and *maxLat* are not specified, they are calculated automatically based on the countries and/or regions selected. The latitude and longitude of the map may be delimited, by just specifying the arguments *minLon*, *maxLon*, *minLat* and *maxLat*.



Example 5

It is also possible to give different colors to the countries, as shown in the following map.



Value

Maps are depicted.

References

Lemon, J., Bolker, B., Oom, S., Klein, E., Rowlingson, B., Wickham, H., Tyagi, A., Eterradossi, O., Grothendieck, G., Toews, M., Kane, J., Turner, R., Witthoft, C., Stander, J., Petzoldt, T., Duursma, R., Biancotto, E., Levy, O., Dutang, C., Solymos, P., Engelmann, R., Hecker, M., Steinbeck, F., Borchers, H., Singmann, H., Toal, T. & Ogle, D. (2014). Various plotting functions. R package version 3.5-7. Available at: https://CRAN.R-project.org/package=plotrix.

Examples

```
## Not run:

#Example 1. The world
@_Build_AdWorld_
F76()

#Example 2. Map of Philippines
@_Build_AdWorld_
F76(Area = "Philippines", main="Philippines")

#Two countries
@_Build_AdWorld_
F76(Area=c("Dominican Republic","Haiti"), main="Haiti and Dominican Republic")

#Example 3. Changes of background color
@_Build_AdWorld_
F76(Area = c("Bahamas") , colbg = "#7FFFD4FF" , colcon = "#CAFF70FF", main="Bahamas")

#Example 4. Selection of latitudes and longitudes in the Bahamas
@_Build_AdWorld_
F76(Area = c("Bahamas") , minLon = -78.1 , maxLon = -77.4 , minLat = 23.6 ,
maxLat = 24.5 , colbg = "#7FFFD4FF" , colcon = "#CAFF70FF", main="Bahamas")

#Example 5. Countries with different colors
@_Build_AdWorld_
F76(minLon=-100, maxLon=-60, minLat=5, maxLat=30, main="Central America",
cex.main=1.4, colcon="#FFFFFF",exclude = c("Anguilla", "Antigua and Barbuda",
"Aruba", "Bahamas", "Barbados", "Central America>Belize",
"Bonaire, Sint Eustatius and Saba", "British Virgin Islands", "Cayman Islands",
"Clipperton Island", "Costa Rica", "Cuba", "Dominica", "Dominican Republic",
"El Salvador", "Grenada", "Guadeloupe", "Central America>Guatemala",
"Haiti", "Honduras", "Jamaica", "Martinique", "Montserrat", "Nicaragua",
"Panama", "Puerto Rico", "Saint Kitts and Nevis",
"Saint Martin", "Saint Vincent and the Grenadines", "Santa Lucia",
"Sint Maarten", "Turks and Caicos Islands", "Virgin Islands") , colexc = "#F0E68CFF")

## End(Not run)
```

F77 *2D FILLED CONTOUR PLOT*

Description

A 2D filled contour plot is depicted.

Usage

```
F77(data, X, Y, Z, FCONTOUR=NULL,  XLAB=NULL, YLAB=NULL, ZLAB=NULL,
COL=NULL, ResetPAR=TRUE, PAR=NULL,  MTEXT= NULL, TEXT=NULL)
```

Arguments

`data`	Data file.
`X`	Variable X.
`Y`	Variable Y.
`Z`	Variable Z.
`FCONTOUR`	It accesses the function filled.contour of base package graphics that allows to modify many different aspects of the 2D plot.
`XLAB`	Legend of the X axis.
`YLAB`	Legend of the Y axis.
`ZLAB`	Legend of the Z axis.
`COL`	Color palette to be used for the image function or for the contours.
`ResetPAR`	If it is FALSE, the default condition of the function PAR is not placed and maintained those defined by the user in previous graphics.
`PAR`	It accesses the function PAR that allows to modify many different aspects of the graph.
`MTEXT`	It allows to add text on the margins of the graph.
`TEXT`	It allows to add text in any area of the inner part of the graph.

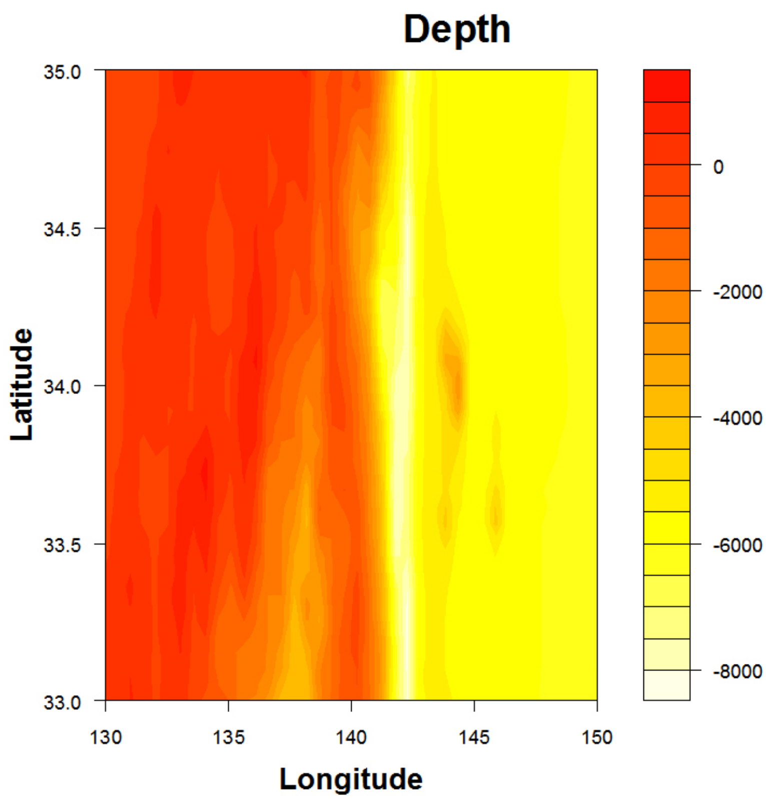
Details

FUNCTIONS

The plot is performed with the functions filled.contour of base package graphics. The matrix is obtained using the function interp of the package akima (Akima et al., 2015). For further details see Guisande & Vammonde (2012).

EXAMPLES

Depth in region of the ocean.



Value

A 2D filled contour plot is depicted.

References

Akima, H., Gebhardt, A., Petzoldt, T & Maechler, M. (2016) Interpolation of irregularly spaced data. R package version 0.6-2. Available at: https://CRAN.R-project.org/package=akima.

Guisande, C. & Vaamonde, A. (2012) Gráficos estadísticos y mapas con R. Ediciones Díaz de Santos, Madrid, 367 pp.

Examples

```
## Not run:

#Including the variable Z as a matrix

data(Z10)
m<-as.matrix(Z10[,c(-1,-2)])
F77(data=Z10,  X="Longitude", Y="Latitude",  Z=m)

#Including only a matrix

data(Z10)
```

```
m<-as.matrix(Z10[,c(-1,-2)])
F77(data=m)

#With data format not as matrix

data(Z11)
F77(data=Z11,  X="Longitude", Y="Latitude", Z="Depth")
## End(Not run)
```

F78 *CHOROPLETH MAPS FOR DEPICTING A VARIABLE OF A EXTERNAL SHAPE*

Description

Polygons of an external shape file are shaded or patterned, and being displayed on the map, in proportion to a variable avaible in the shape file or a vector with a variable.

Usage

```
F78(data, var, admAreas=FALSE, Area="World", minLon, maxLon, minLat, maxLat,
int=30, colbg="#FFFFFF", colcon="#C8C8C8", colf="black", pro=TRUE, inc=0.005,
exclude=NULL, colexc=NULL, colfexc="black", colscale=rev(heat.colors(100)),
legend.pos="y", breaks=10, xl=0, xr=0, yb=0, yt=0, asp, lab=NULL,
xlab="Longitude", ylab="Latitude", main=NULL, cex.main=1.6, cex.lab=1.4,
cex.axis=1.2, cex.legend=0.9, family="sans", font.main=2, font.lab=1,
font.axis=1, lwdP=0.6, lwdC=0.1, trans=c(1,1), log=c(0,0), ndigits=0,
ini=NULL, end=NULL, jpg=FALSE, filejpg="Map.jpg")
```

Arguments

`data`	A shape file.
`var`	A variable available in the shape file or a vector with the values of the variable.
`admAreas`	If it is TRUE the border lines of the countries are depicted in the map.
`Area`	Only if using RWizard (http://www.ipez.es/RWizard/). A character with the name of the administrative area or a vector with several administrative areas (countries, regions, etc.) or river basins. If it is "World" (default) the entire world is plotted. For using administrative areas or river basins, in addition to use RWizard, it is also necessary to replace data(world) by @_Build_AdWorld_ (see examples).
`minLon, maxLon`	Optionally it is possible to define the minimum and maximum longitude.
`minLat, maxLat`	Optionally it is possible to define the minimum and maximum latitude.
`int`	Number of intervals into which the variable is splited.
`colbg`	Background color of the map (in some cases this is the sea).
`colcon`	Background color of the administrative areas.

colf	Color of administrative areas border.
pro	If it is TRUE an automatic calculation is made in order to correct the aspect ratio y/x along latitude.
inc	Adds some room along the map margins with the limits x and y thus not exactly the limits of the selected areas.
exclude	A character with the name of the administrative area or a vector with several administrative areas that may be plotted with a different color on the map (only if using RWizard).
colexc	Background color of areas selected in the argument exclude.
colfexc	Color of borders of the areas selected in the argument exclude.
colscale	Palette color.
legend.pos	Whether to have a horizontal "x" or vertical "y" color scale.
breaks	Number of breakpoints of the color legend.
xl,xr,yb,yt	The lower left and upper right coordinates of the color legend in user coordinates.
asp	The y/x aspect ratio.
lab	A numerical vector of the form c(x, y) which modifies the default way that axes are annotated. The values of x and y give the (approximate) number of tickmarks on the x and y axes.
xlab	A title for the X axis.
ylab	A title for the Y axis.
main	An overall title for the plot.
cex.main	The magnification to be used for main titles relative to the current setting of cex.
cex.lab	The magnification to be used for X and Y labels relative to the current setting of cex.
cex.axis	The magnification to be used for axis annotation relative to the current setting of cex.
cex.legend	The magnification to be used for the color scale relative to the current setting of cex.
family	The name of a font family for drawing text.
font.main	The font to be used for plot main titles.
font.lab	The font to be used for x and y labels.
font.axis	The font to be used for axis annotation.
lwdP	Line width of the plot.
lwdC	Line width of the borders.
trans	It is possible to multiply or divide the dataset by a value. For a vector with two values, the first may be 0 (divide) or 1 (multiply), and the second number is the value of the division or multiplication.
log	It is possible to apply a logarithmic transformation to the dataset. For a vector with two values, the first may be 0 (do not log transform) or 1 (log transformation), and the second number is the value to be added in case of log transformation.

`ndigits`	Number of decimals in legend of the color scale.
`ini`	Minimum to be considered in the color scale.
`end`	Maximum to be considered in the color scale.
`jpg`	If TRUE the plots are exported to jpg files instead of using the windows device.
`filejpg`	Name of the jpg file.

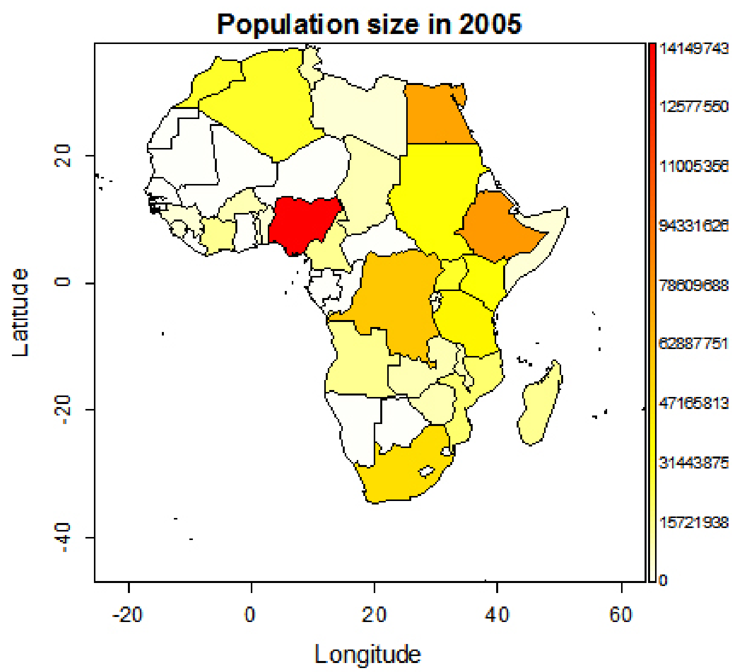
Details

FUNCTIONS

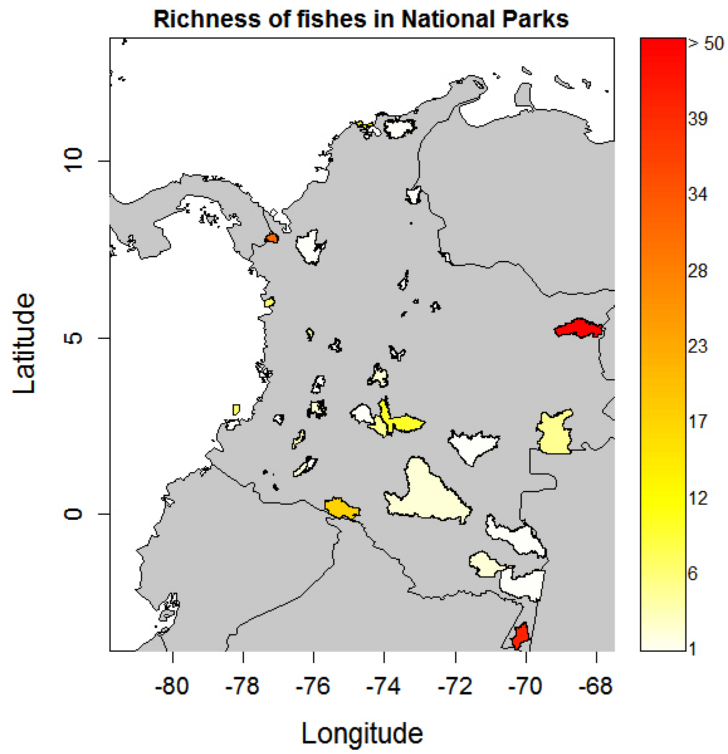
The function color.legend of the package plotrix (Lemon et al., 2014) is used for building the map.

EXAMPLE

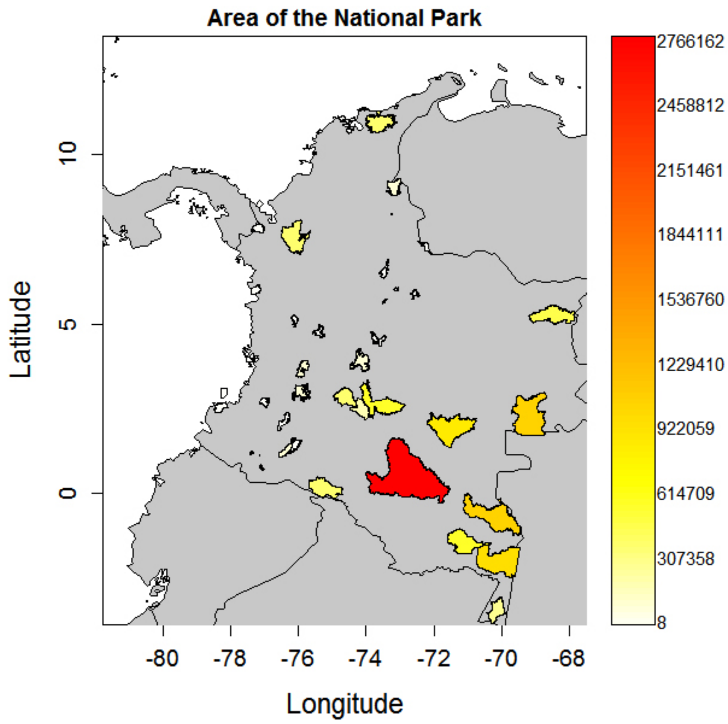
Example 1. Population size of countries in Africa.



Example 2. Species richness of freshwater fishes in National Parks of Colombia. An example using a vector with the variable and including administrative areas available in RWizard



Example 3. Area of National Parks in Colombia. A example using a variable available in the file of the shapes and including administrative areas available in RWizard.



Value

A map is obtained.

References

Lemon, J. (2006) Plotrix: a package in the red light district of R. *R-News*, 6(4):8-12.

Lemon, J., Bolker, B., Oom, S., Klein, E., Rowlingson, B., Wickham, H., Tyagi, A., Eterradossi, O., Grothendieck, G., Toews, M., Kane, J., Turner, R., Witthoft, C., Stander, J., Petzoldt, T., Duursma, R., Biancotto, E., Levy, O., Dutang, C., Solymos, P., Engelmann, R., Hecker, M., Steinbeck, F., Borchers, H., Singmann, H., Toal, T. & Ogle, D. (2015). Various plotting functions. R package version 3.6-1. Available at: https://CRAN.R-project.org/package=plotrix.

Examples

```
## Not run:

#Example 1. Without including administrative areas available in RWizard

data(Z27)
data(adworld)
F78(data=Z27, var="POP2005", main="Population size in 2005")

#Example 2. Using a vector with the richness of freshwater fishes in each National Park of
#Colombia and including administrative areas available in RWizard
```

```
data(Z26)
data(adworld)
richness1<-c(1, 6, 1, 2, 7, 1, 3, 1, 1, 2, 8, 3, 3, 2, 1, 1, 14, 34, 1, 1, 1, 1, 1, 1, 1)
richness2<-c(1, 1 , 5, 1, 3, 3, 1, 176, 1, 6, 1, 6, 1, 1, 44, 1, 1, 12, 4, 19, 9, 1, 1, 6)
richness<-append(richness1, richness2)
F78(data=Z26, var=richness, admAreas=TRUE, main="Richness of fishes in National Parks",
cex.main=1.2, end=50)

#Example 3. Using a variable available in the file of the shapes
#and including administrative areas available in RWizard

data(Z26)
data(adworld)
F78(data=Z26, var="Area_Res", admAreas=TRUE, main="Area of the National Park",
cex.main=1.2)


## End(Not run)
```

F79 *CHOROPLETH MAPS FOR DEPICTING A VARIABLE NOT INCLUDED IN A SHAPE*

Description

It allows to shade the polygons in proportion to a variable of a data frame using the polygons available in RWizard or the polygons of a external shape.

Usage

```
F79(data, polygonname, var, shape=NULL, shapenames=NULL, admAreas=TRUE,
Area="World", minLon, maxLon, minLat, maxLat, int=30, colbg="#FFFFFF",
colcon="#C8C8C8", colf="black", pro=TRUE, inc=0.005, exclude=NULL,
colexc=NULL, colfexc="black", colscale=rev(heat.colors(100)), legend.pos="y",
breaks=10, xl=0, xr=0, yb=0, yt=0, asp, lab=NULL, xlab="Longitude",
ylab="Latitude", main=NULL, cex.main=1.6, cex.lab=1.4, cex.axis=1.2,
cex.legend=0.9, family="sans", font.main=2, font.lab=1, font.axis=1,
lwdP=0.6, lwdC=0.1, trans=c(1,1), log=c(0,0), ndigits=0, ini=NULL,
end=NULL, jpg=FALSE, filejpg="Map.jpg")
```

Arguments

`data`	Data file with the variable.
`polygonname`	A variable available in the data file with the names of the polygons.
`var`	A variable available in the data file with the values to be used for shading the polygons.
`shape`	If the polygons are in a external shape file, it is necessary to indicate the file in this argument. It is not necessary to select any polygon within the file, just to load the whole shape file.

`shapenames`	Variable in the shapefile with the names of the polygons.
`admAreas`	If it is TRUE the border lines of the countries are depicted in the map.
`Area`	Only if using RWizard (http://www.ipez.es/RWizard/). A character with the name of the administrative area or a vector with several administrative areas (countries, regions, etc.) or river basins. If it is "World" (default) the entire world is plotted. For using administrative areas or river basins, in addition to use RWizard, it is also necessary to replace data(world) by @_Build_AdWorld_ (see examples).
`minLon, maxLon`	Optionally it is possible to define the minimum and maximum longitude.
`minLat, maxLat`	Optionally it is possible to define the minimum and maximum latitude.
`int`	Number of intervals into which the variable is splited.
`colbg`	Background color of the map (in some cases this is the sea).
`colcon`	Background color of the administrative areas.
`colf`	Color of administrative areas border.
`pro`	If it is TRUE an automatic calculation is made in order to correct the aspect ratio y/x along latitude.
`inc`	Adds some room along the map margins with the limits x and y thus not exactly the limits of the selected areas.
`exclude`	A character with the name of the administrative area or a vector with several administrative areas that may be plotted with a different color on the map (only if using RWizard).
`colexc`	Background color of areas selected in the argument exclude.
`colfexc`	Color of borders of the areas selected in the argument exclude.
`colscale`	Palette color.
`legend.pos`	Whether to have a horizontal "x" or vertical "y" color scale.
`breaks`	Number of breakpoints of the color legend.
`xl,xr,yb,yt`	The lower left and upper right coordinates of the color legend in user coordinates.
`asp`	The y/x aspect ratio.
`lab`	A numerical vector of the form c(x, y) which modifies the default way that axes are annotated. The values of x and y give the (approximate) number of tickmarks on the x and y axes.
`xlab`	A title for the X axis.
`ylab`	A title for the Y axis.
`main`	An overall title for the plot.
`cex.main`	The magnification to be used for main titles relative to the current setting of cex.
`cex.lab`	The magnification to be used for X and Y labels relative to the current setting of cex.
`cex.axis`	The magnification to be used for axis annotation relative to the current setting of cex.

`cex.legend`	The magnification to be used for the color scale relative to the current setting of cex.
`family`	The name of a font family for drawing text.
`font.main`	The font to be used for plot main titles.
`font.lab`	The font to be used for x and y labels.
`font.axis`	The font to be used for axis annotation.
`lwdP`	Line width of the plot.
`lwdC`	Line width of the borders.
`trans`	It is possible to multiply or divide the dataset by a value. For a vector with two values, the first may be 0 (divide) or 1 (multiply), and the second number is the value of the division or multiplication.
`log`	It is possible to apply a logarithmic transformation to the dataset. For a vector with two values, the first may be 0 (do not log transform) or 1 (log transformation), and the second number is the value to be added in case of log transformation.
`ndigits`	Number of decimals in legend of the color scale.
`ini`	Minimum to be considered in the color scale.
`end`	Maximum to be considered in the color scale.
`jpg`	If TRUE the plots are exported to jpg files instead of using the windows device.
`filejpg`	Name of the jpg file.

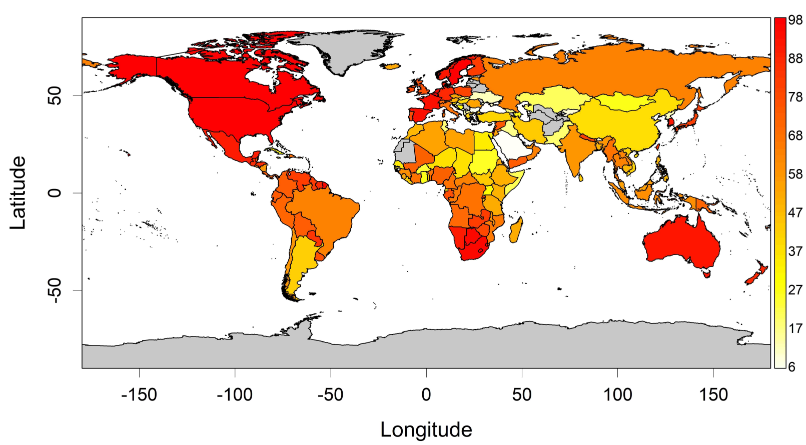
Details

FUNCTIONS

The function color.legend of the package plotrix (Lemon et al., 2014) is used for building the map.

EXAMPLE

Completeness of the records of freshwater fish species in all countries of the world.



Value

A map is obtained.

References

Lemon, J. (2006) Plotrix: a package in the red light district of R. *R-News*, 6(4):8-12.

Lemon, J., Bolker, B., Oom, S., Klein, E., Rowlingson, B., Wickham, H., Tyagi, A., Eterradossi, O., Grothendieck, G., Toews, M., Kane, J., Turner, R., Witthoft, C., Stander, J., Petzoldt, T., Duursma, R., Biancotto, E., Levy, O., Dutang, C., Solymos, P., Engelmann, R., Hecker, M., Steinbeck, F., Borchers, H., Singmann, H., Toal, T. & Ogle, D. (2015). Various plotting functions. R package version 3.6-1. Available at: https://CRAN.R-project.org/package=plotrix.

Examples

```
## Not run:

data(Z28)
data(adworld)
F79(data=Z28, polygonname="Area", var="Completeness")

## End(Not run)
```

F80 *JOYPLOT SEVERAL VARIABLES*

Description

It performs a joyplot for several variables and the overlap of the area under de curve among variables is also estimated.

Usage

```
F80(data, var, kernel="gaussian", PLOT=NULL, overlap=TRUE, lty=1, lwd=2.5,
ResetPAR=TRUE, PAR=NULL, XLAB=NULL, XLIM=NULL, YLIM=NULL, COLOR=NULL,
COLORB=NULL, AXIS=NULL, CEX=1.2, file="Output.csv", na="NA", dec=",",
row.names=FALSE)
```

Arguments

`data`	Data file.
`var`	Variables.
`kernel`	A character string giving the smoothing kernel to be used. This must be one of "gaussian", "rectangular", "triangular", "epanechnikov", "biweight", "cosine" or "optcosine". For further details about the estimation of the density curve see the details section of the function density of base stats package.
`PLOT`	It allows to specify the characteristics of the function plot.default.

`overlap`	If it is TRUE the overlap of the area under the curve among variables is estimated. For further details about the estimation of the area under the curve see the details section of the function auc of the package kulife (Ekstrom et al., 2015).
`lty`	Type of line of the density curve for each variable. If it is a vector, it must be as many as different variables. See the description of the same argument in the function F1.
`lwd`	Line width relative to the default (default=1), so 2 is twice as wide.
`ResetPAR`	If it is FALSE, the default condition of the function PAR is not placed and maintained those defined by the user in previous graphics.
`PAR`	It accesses the function PAR that allows to modify many different aspects of the graph.
`XLAB`	Legend of the X axis.
`XLIM`	Vector with the limits of the X axis.
`YLIM`	Vector with the limits of the Y axis.
`COLOR`	Color of the density curves. It must be as many as different variables.
`COLORB`	Color of the lines. It must be as many as different variables.
`AXIS`	It allows to add axes to the graph.
`CEX`	Size of the labels of each group and of the legend of X axis.
`file`	CSV FILE. File name with the overlap of the area under the curve among variables.
`na`	CSV FILE. Text that is used in the cells without data.
`dec`	CSV FILE. It defines if the comma "," is used as decimal separator or the dot ".".
`row.names`	CSV FILE. Logical value that defines if identifiers are put in rows or a vector with a text for each of the rows.

Details

FUNCTIONS

The plot is performed with the function plot.default of base graphics package.

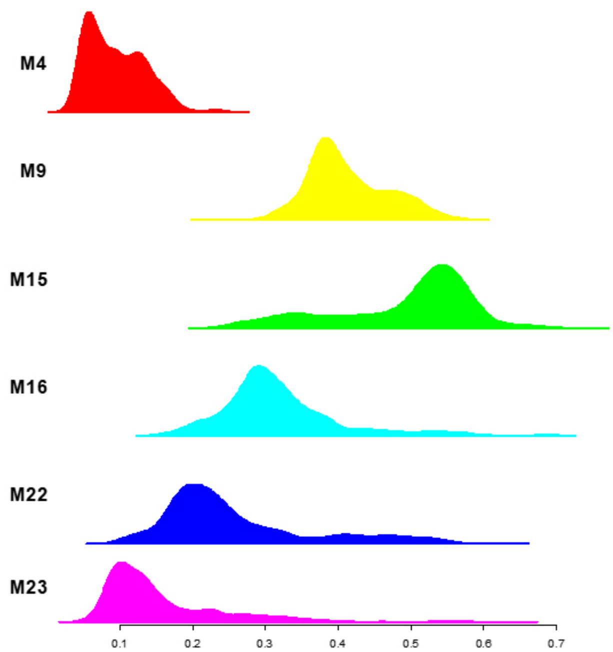
The density curve is estimated with the function density of base stats package.

The area under the curve is estimated with the function auc of the package kulife (Ekstrom et al., 2015).

EXAMPLES

For the examples, morphometric data of three families of freshwater fishes, as the distance from the origin of the dorsal fin to the origin of the anal fin (M13), the length of the dorsal fin base (M12), body height (M11), etc., are used. For details see Guisande et al. (2010).

A joypplot is depicted with some variables. The overlap of the area under the curve among variables is obtained in the results. For instance, the overlap is 18.3% between M4 and M9.



Value

A joyplot for several variables and a CSV file with the overlap of the area under de curve among variables are obtained.

References

Ekstrom, C., Skovgaard, Ib M. & Martinussen, T.(2015) Datasets and functions from the (now non-existing). R package version 0.1-14. Available at: https://CRAN.R-project.org/package=kulife.

Guisande, C., Manjarrés-Hernández, A., Pelayo-Villamil, P., Granado-Lorencio, C., Riveiro, I., Acuña, A., Prieto-Piraquive, E., Janeiro, E., Matías, J.M., Patti, C., Patti, B., Mazzola, S., Jiménez, S., Duque, V. & Salmerón, F. (2010) IPez: An expert system for the taxonomic identification of fishes based on machine learning techniques. *Fisheries Research*, 102, 240-247.

Examples

```
## Not run:

data(Z8)

F80(data=Z8, var=c("M4", "M9", "M15", "M16","M22","M23"))

## End(Not run)
```

F81 *JOYPLOT FOR ONE VARIABLE WITH DIFFERENT GROUPS*

Description

It performs a joyplot of one variable with different groups and the overlap of the area under de curve among groups is also estimated.

Usage

```
F81(data, var, group, kernel="gaussian", PLOT=NULL, overlap=TRUE,
lty=1, lwd=2.5, ResetPAR=TRUE, PAR=NULL, XLAB=NULL, XLIM=NULL, YLIM=NULL,
COLOR=NULL, COLORB=NULL, AXIS=NULL, CEX=1.2, file="Output.csv",
na="NA", dec=",", row.names=FALSE)
```

Arguments

`data`	Data file.
`var`	Variables.
`group`	Variable with the categories to be grouped.
`kernel`	A character string giving the smoothing kernel to be used. This must be one of "gaussian", "rectangular", "triangular", "epanechnikov", "biweight", "cosine" or "optcosine". For further details about the estimation of the density curve see the details section of the function density of base stats package.
`PLOT`	It allows to specify the characteristics of the function plot.default.
`overlap`	If it is TRUE the overlap of the area under the curve among variables is estimated. For further details about the estimation of the area under the curve see the details section of the function auc of the package kulife (Ekstrom et al., 2015).
`lty`	Type of line of the density curve for each variable. If it is a vector, it must be as many as different variables. See the description of the same argument in the function F1.
`lwd`	Line width relative to the default (default=1), so 2 is twice as wide.
`ResetPAR`	If it is FALSE, the default condition of the function PAR is not placed and maintained those defined by the user in previous graphics.
`PAR`	It accesses the function PAR that allows to modify many different aspects of the graph.
`XLAB`	Legend of the X axis.
`XLIM`	Vector with the limits of the X axis.
`YLIM`	Vector with the limits of the Y axis.
`COLOR`	Color of the density curves. It must be as many as different groups.
`COLORB`	Color of the lines. It must be as many as different groups.

AXIS	It allows to add axes to the graph.
CEX	Size of the labels of each group and of the legend of X axis.
file	CSV FILE. File name with the overlap of the area under the curve among groups.
na	CSV FILE. Text that is used in the cells without data.
dec	CSV FILE. It defines if the comma "," is used as decimal separator or the dot ".".
row.names	CSV FILE. Logical value that defines if identifiers are put in rows or a vector with a text for each of the rows.

Details

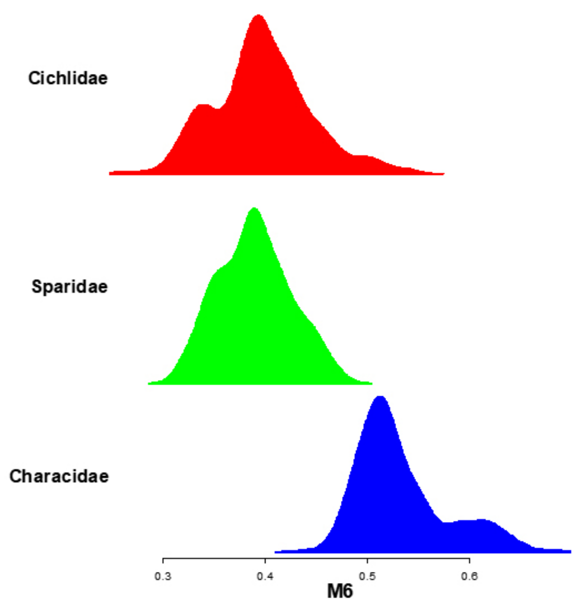
FUNCTIONS

The plot is performed with the function plot.default of base graphics package. The density curve is estimated with the function density of base stats package. The area under the curve is estimated with the function auc of the package kulife (Ekstrom et al., 2015).

EXAMPLES

For the example, morphometric data of three families of freshwater fishes, as the distance from the origin of the dorsal fin to the origin of the anal fin (M13), the length of the dorsal fin base (M12), body height (M11), etc., are used. For details see Guisande et al. (2010).

A joyplot plot is depicted for the variable M6 for each family.



The overlap of the area under the curve among families is obtained. The 87.87% of the area of the family Cichlidae overlaps with the family Sparidae, the 9.74% of the area of the family Cichlidae overlaps with the family Characidae, 87.69% of the area of the family Sparidae overlaps with the family Cichlidae, etc.

Value

A joyplot for one variable with different groups and a CSV file with the overlap of the area under de curve among groups are obtained.

References

Ekstrom, C., Skovgaard, Ib M. & Martinussen, T.(2015) Datasets and functions from the (now non-existing). R package version 0.1-14. Available at: https://CRAN.R-project.org/package=kulife.

Guisande, C., Manjarrés-Hernández, A., Pelayo-Villamil, P., Granado-Lorencio, C., Riveiro, I., Acuña, A., Prieto-Piraquive, E., Janeiro, E., Matías, J.M., Patti, C., Patti, B., Mazzola, S., Jiménez, S., Duque, V. & Salmerón, F. (2010) IPez: An expert system for the taxonomic identification of fishes based on machine learning techniques. *Fisheries Research*, 102, 240-247.

Examples

```
## Not run:

data(Z8)

F81(data=Z8, var="M6", group="Family")

## End(Not run)
```

F82 *MULTIPLE SCATTER PLOTS WITH MARGINAL HISTROGRAMS*

Description

It performs a multiple scatter plot with or without text labels, regression model and marginal histograms.

Usage

```
F82(data, varY, varX, group, textlabel=NULL, label=NULL, MAR1=c(5,5,1,1),
MAR2=c(1,5,1,1), MAR3=c(5,1,1,1), reg=FALSE, model="Linear", outliers=FALSE,
quant1=0.05, quant2 = 0.95, ResetPAR=FALSE, PAR=NULL, XLAB=NULL, YLAB=NULL,
COLOR=NULL, COLORR=NULL, PCH=NULL, CEX=1,  lty=NULL, lwd=2.5, PLOT=NULL,
LEGEND=NULL,  AXIS=NULL, MTEXT= NULL, TEXT=NULL, HIST=NULL, HISTh=NULL,
breaks=20, COLORl=NULL, COLORb=NULL, dec=",", file="Output.txt")
```

Arguments

data	Data file.
varY	Dependent variable.
varX	Quantitative independent variable.

group	Variable with the categories to be grouped.
textlabel	Optionally, variable with the text labels.
label	It allows to specify the characteristics of the text labels with the function text.
MAR1	A numeric vector with the format c(down, left, up, right) that defines the lines of the margins of the scatter plot.
MAR2	A numeric vector with the format c(down, left, up, right) that defines the lines of the margins of the upper histogram.
MAR3	A numeric vector with the format c(down, left, up, right) that defines the lines of the margins of the right side histogram.
reg	If TRUE a regression model is performed.
model	One regression model can be selected: "Linear" , "Log", "S-curve", "Power", "Exp", "Quadratic", "Cubic", "Inverse". It is not considered the model in those cases in which there is the logarithm that apply to any of the variables, if any value of the variable, which applies the logarithm, is zero or negative. The inverse model is not calculated if any value of the independent variable is zero.
outliers	If it is TRUE, the outliers are removed using the selected regression model.
quant1	Quantile of the lower end to the elimination of outliers.
quant2	Quantile of the upper end to the elimination of outliers.
ResetPAR	If it is FALSE, the default condition of the function PAR is not placed and maintained those defined by the user in previous graphics.
PAR	It accesses the function PAR that allows to modify many different aspects of the graph.
XLAB	Legend of the X axis.
YLAB	Legend of the Y axis.
COLOR	Color of the symbols. It must be as many as different categories of the variable *group*.
COLORR	Color of the line of the regression model. It must be as many as different categories of the variable *group*.
PCH	Graphic symbol (see the description of the same argument in the function F1). It must be as many as different categories of the variable *group*.
CEX	Size of the symbols.
lty	Type of the regression line (see the description of the same argument in the function F1).
lwd	Line width of the regression line relative to the default (default=1), so 2 is twice as wide.
PLOT	It allows to specify the characteristics of the function plot.default.
LEGEND	It allows to modify the legend of the graph.
AXIS	It allows to add axes to the graph.
MTEXT	It allows to add text on the margins of the graph.
TEXT	It allows to add text in any area of the inner part of the graph.

`HIST`	It allows to specify the characteristics of the upper histogram with the function hist.
`HISTh`	It allows to specify the characteristics of the right side histogram with the function barplot.
`breaks`	Number of intervals.
`COLORl`	Color of the borders. It must be as many as different variables.
`COLORb`	Color of ther bars. It must be as many as different variables.
`dec`	It defines if the comma "," is used as decimal separator or the dot ".".
`file`	TXT FILE. If the argument *reg=TRUE* a TXT file is saved with the information of the regression.

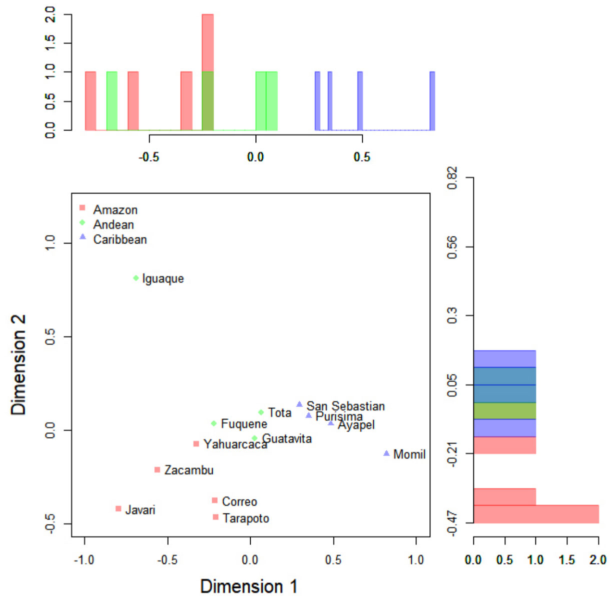
Details

FUNCTIONS

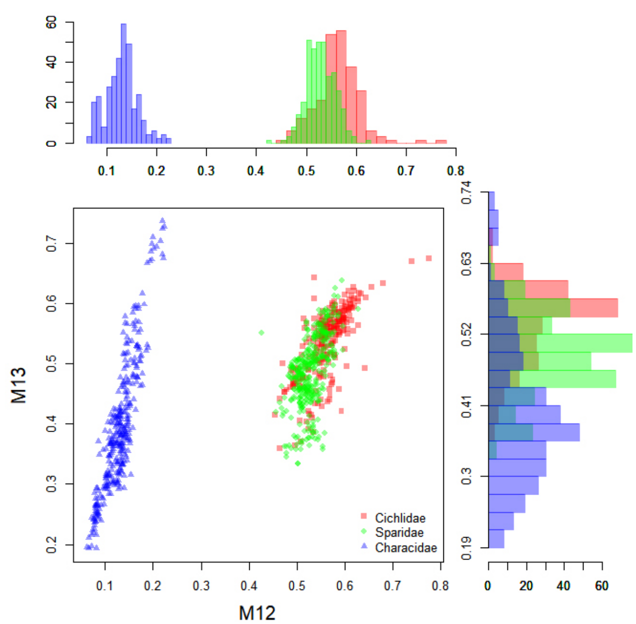
The scatter plot is performed with the function plot.default of base graphics package and the linear regression with the function lm of base stats package. The function lillie.test of the package nortest (Gross, 2013) is used to perform the test of Normality Kolmogorov-Smirnov with Lilliefors'correction, the function dwtest of the package lmtest (Hothorn et al., 2013) to analyze the autocorrelation with the test and the Durbin-Watson statistic function bptest of the package lmtest (Hothorn et al., 2013) to perform the Breusch-Pagan test of homoscedasticity. The histograms are performed with the functions hist and barplot of base graphics package.

EXAMPLES

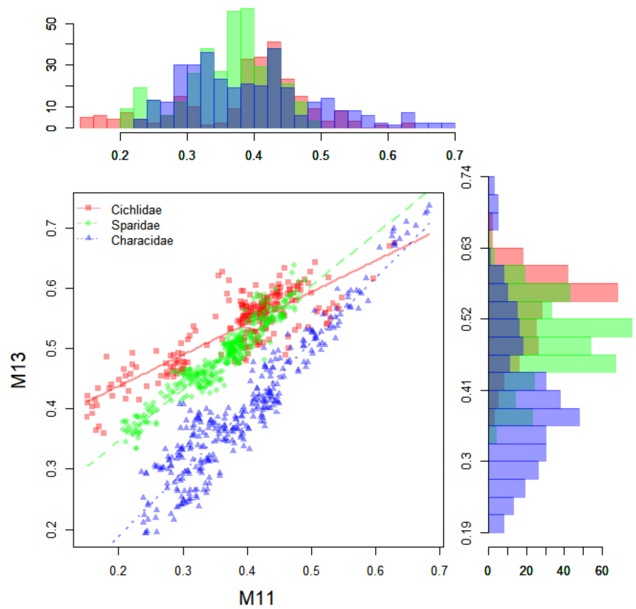
Example 1 The data are scores of a Principal Component Analysis (PCA) performed to physicochemical parameters from lakes in Colombia. In this example, text labels are assigned to the points with the argument *textlabel="Lake"*, and the different regions are identified with the argument *group="Region"*.



Example 2 For the examples, morphometric data of several fish species of Characiforms, as the distance from the origin of the dorsal fin to the origin of the anal fin (M13), the length of the dorsal fin base (M12), body height (M11), etc., are used. For details see Guisande et al. (2010). It is shown the relationship between M12 and M13 for each genera.



Example 3 A linear regression line is added to the example 2 with the argument *reg=TRUE*.



In the TXT file that generates the function, the regression model of each genera is shown. For the explanation of the regression models, normality, autocorrelation and homoscedasticity see the *details* section of the function F1.

Value

A multiple scatter plot with or without linear regression and marginal histrograms is obtained. Moreover, a TXT file is saved with the results of the regression model.

References

Durbin, J. & Watson G.S. (1951) Testing for serial correlation in least squares regression. *Biometrika*, **38**, 159-171.

Gross, J. (2013) Tests for Normality. R package version 1.0-2. Available at: `https://CRAN.R-project.org/package=nortest`.

Guisande, C., Manjarrés-Hernández, A., Pelayo-Villamil, P., Granado-Lorencio, C., Riveiro, I., Acuña, A., Prieto-Piraquive, E., Janeiro, E., Matías, J.M., Patti, C., Patti, B., Mazzola, S., Jiménez, S., Duque, V. & Salmerón, F. (2010) IPez: An expert system for the taxonomic identification of fishes based on machine learning techniques. *Fisheries Research*, 102, 240-247.

Hothorn, T. et al., (2013) Testing Linear Regression Models. R package version 0.9-33. Available at: `https://CRAN.R-project.org/package=lmtest`.

Examples

```
## Not run:

#Example 1
```

```
data(Z6)

F82(data=Z6 , varY="Dimension2", varX="Dimension1", group="Region",
textlabel="Lake", XLAB="Dimension 1", YLAB="Dimension 2", PLOT=c("xlim=c(-1,1)",
"ylim=c(-0.5,1.2),", "xlab=xlab", "ylab=ylab", "col=COLOR", "pch=PCH"))

#Example 2

data(Z8)

F82(data=Z8, varY="M13", varX="M12", group="Family", LEGEND = c("x='bottomright'",
"legend=dati", "pch=PCH", "col=COLOR" , "lty=lty" , "bty='n'"))

#Example 3

data(Z8)

F82(data=Z8, varY="M13", varX="M11", group="Family", reg=TRUE)

## End(Not run)
```

F83 *MULTIPLE MEAN WITH ERROR BARS SCATTER PLOTS WITH MARGINAL HISTROGRAMS*

Description

It performs a multiple mean with error bars scatter plot with or without text labels, regression model and marginal histograms.

Usage

```
F83(data, varY, varX, Factor, group, method="mean", dev="sd", barY=TRUE,
barX=FALSE, textlabel=NULL, label=NULL, MAR1=c(5,5,1,1), MAR2=c(1,5,1,1),
MAR3=c(5,1,1,1), reg=FALSE, model="Linear", outliers=FALSE, quant1=0.05,
quant2 = 0.95, ResetPAR=FALSE, PAR=NULL, XLAB=NULL, YLAB=NULL, XLIM=NULL,
YLIM=NULL, COLOR=NULL, COLORI="black", COLORR=NULL, PCH=NULL, CEX=1.5, lty=NULL,
lwd=2.5, PLOT=NULL, LEGEND=NULL, AXIS=NULL, MTEXT= NULL, TEXT=NULL,
HIST=NULL, HISTh=NULL, breaks=20, COLORl=NULL, COLORb=NULL, file1="Output.txt",
file2="Average and error bars.csv", na="NA", dec=",", row.names=FALSE)
```

Arguments

`data`	Data file.
`varY`	Dependent variable.
`varX`	Quantitative independent variable.

`Factor`	Variable for the estimation of the average and error bars for each category of the variable. It is not possible to include variables with any of the categories with a single data, so if necessary several data for each category.
`group`	Variable with the categories to be grouped.
`method`	The average of each category of the grouped variable *Factor* is estimated with the "mean" or the "median".
`dev`	The error bars may be estimated using the standard deviation ("sd") or the standard error ("se").
`barY`	If it is TRUE the bar error of the variable Y is depicted.
`barX`	If it is TRUE the bar error of the variable X is depicted.
`textlabel`	Optionally, variable with the text labels.
`label`	It allows to specify the characteristics of the text labels with the function text.
`MAR1`	A numeric vector with the format c(down, left, up, right) that defines the lines of the margins of the scatter plot.
`MAR2`	A numeric vector with the format c(down, left, up, right) that defines the lines of the margins of the upper histogram.
`MAR3`	A numeric vector with the format c(down, left, up, right) that defines the lines of the margins of the right side histogram.
`reg`	If TRUE a regression model is performed.
`model`	One regression model can be selected: "Linear" , "Log", "S-curve", "Power", "Exp", "Quadratic", "Cubic", "Inverse". It is not considered the model in those cases in which there is the logarithm that apply to any of the variables, if any value of the variable, which applies the logarithm, is zero or negative. The inverse model is not calculated if any value of the independent variable is zero.
`outliers`	If it is TRUE, the outliers are removed using the selected regression model.
`quant1`	Quantile of the lower end to the elimination of outliers.
`quant2`	Quantile of the upper end to the elimination of outliers.
`ResetPAR`	If it is FALSE, the default condition of the function PAR is not placed and maintained those defined by the user in previous graphics.
`PAR`	It accesses the function PAR that allows to modify many different aspects of the graph.
`XLAB`	Legend of the X axis.
`YLAB`	Legend of the Y axis.
`XLIM`	Vector with the limits of the X axis.
`YLIM`	Vector with the limits of the Y axis.
`COLOR`	Color of the symbols. It must be as many as different categories of the variable *group*.
`COLORI`	Color of the error bars.
`COLORR`	Color of the line of the regression model. It must be as many as different categories of the variable *group*.

`PCH`	Graphic symbol (see the description of the same argument in the function F1). It must be as many as different categories of the variable *group*.
`CEX`	Size of the symbols.
`lty`	Type of the regression line (see the description of the same argument in the function F1).
`lwd`	Line width of the regression line relative to the default (default=1), so 2 is twice as wide.
`PLOT`	It allows to specify the characteristics of the function plot.default.
`LEGEND`	It allows to modify the legend of the graph.
`AXIS`	It allows to add axes to the graph.
`MTEXT`	It allows to add text on the margins of the graph.
`TEXT`	It allows to add text in any area of the inner part of the graph.
`HIST`	It allows to specify the characteristics of the upper histogram with the function hist.
`HISTh`	It allows to specify the characteristics of the right side histogram with the function barplot.
`breaks`	Number of intervals.
`COLORl`	Color of the borders. It must be as many as different variables.
`COLORb`	Color of ther bars. It must be as many as different variables.
`file1`	TXT FILE. If the argument *reg=TRUE* a TXT file is saved with the information of the regression.
`file2`	CSV FILE. File name with the mean, median, standard error and standard deviation for each category of the variable *Factor*
`na`	CSV FILES. Text that is used in the cells without data.
`dec`	CSV FILES. It defines if the comma "," is used as decimal separator or the dot ".".
`row.names`	CSV FILES. Logical value that defines if identifiers are put in rows or a vector with a text for each of the rows.

Details

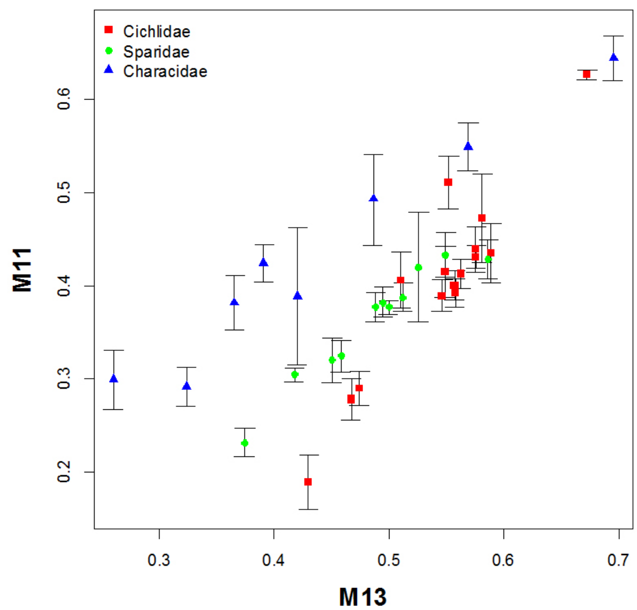
See the equations of all regression models in the section *details* of the function XI1 of the package StatR.

FUNCTIONS

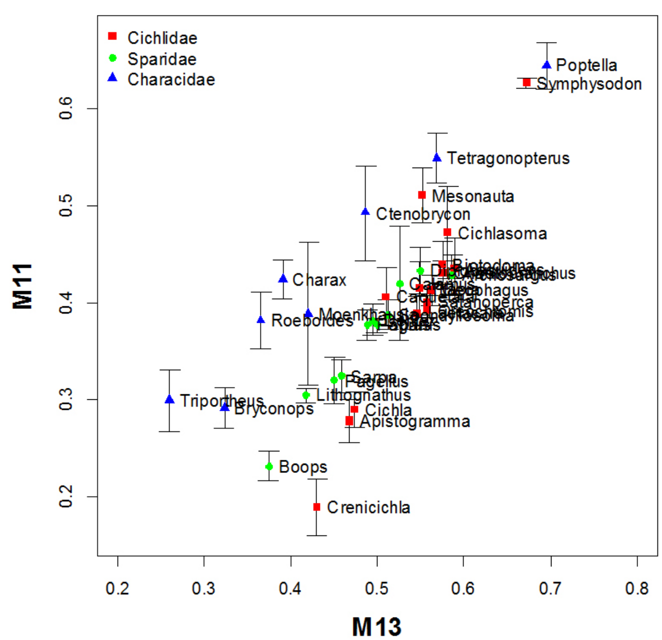
The scatter plot is performed with the function plot.default of base graphics package and the linear regression with the function lm of base stats package. The function lillie.test of the package nortest (Gross, 2013) is used to perform the test of Normality Kolmogorov-Smirnov with Lilliefors'correction, the function dwtest of the package lmtest (Hothorn et al., 2013) to analyze the autocorrelation with the test and the Durbin-Watson statistic function bptest of the package lmtest (Hothorn et al., 2013) to perform the Breusch-Pagan test of homoscedasticity. The histograms are performed with the functions hist and barplot of base graphics package.

EXAMPLES

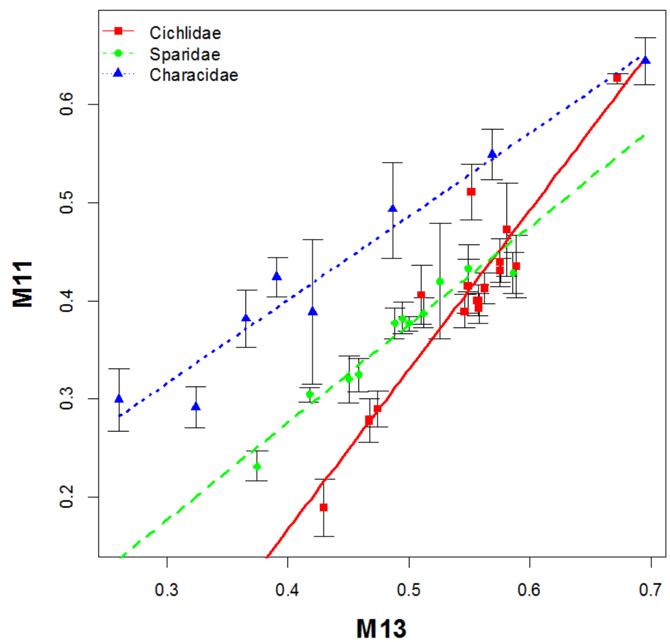
Example 1. Relationship between the mean values of M13 and M11 for each genera with the standard deviation of the M11, and grouped by families.



Example 2. Relationship between the mean values of M6 and M7 for each family but adding the text labels of the genera with the argument *textlabel=TRUE*.



Example 3. As in the example 1 but a linear regression line is added for each family with the argument *reg=TRUE*.



In the TXT file that generates the function, the regression model of each family is shown. For the explanation of the regression models, normality, autocorrelation and homoscedasticity see the *details* section of the function F1.

Value

A multiple scatter plot with mean error bars, with or without linear regression, with or without text labels and with marginal histograms is obtained. A CVS file with the mean, median, standard error and standard deviation for each category of the variable *Factor* is also obtained.

References

Durbin, J. & Watson G.S. (1951) Testing for serial correlation in least squares regression. *Biometrika*, **38**, 159-171.

Gross, J. (2013) Tests for Normality. R package version 1.0-2. Available at: `https://CRAN.R-project.org/package=nortest`.

Guisande, C., Manjarrés-Hernández, A., Pelayo-Villamil, P., Granado-Lorencio, C., Riveiro, I., Acuña, A., Prieto-Piraquive, E., Janeiro, E., Matías, J.M., Patti, C., Patti, B., Mazzola, S., Jiménez, S., Duque, V. & Salmerón, F. (2010) IPez: An expert system for the taxonomic identification of fishes based on machine learning techniques. *Fisheries Research*, 102, 240-247.

Hothorn, T. et al., (2013) Testing Linear Regression Models. R package version 0.9-33. Available at: `https://CRAN.R-project.org/package=lmtest`.

Examples

```
## Not run:

data(Z8)

#Example 1

F83(data=Z8, varY="M11", varX="M13", Factor="Genus", group="Family")

#Example 2

F83(data=Z8, varY="M6", varX="M7", Factor="Family",
group="Family", textlabel=TRUE, XLIM=c(0.35,0.55))

#Example 3

F83(data=Z8, varY="M11", varX="M13", Factor="Genus",
group="Family",reg=TRUE)

## End(Not run)
```

`F84` *ADDITIONAL AXES IN LINE CHARTS AND SCATTER PLOTS FOR VARIABLE X QUANTITATIVE*

Description

It is possible to add up to 3 additional axes to line charts and scatterplots with or without text labels, and a regression model.

Usage

```
F84(data, varX, varY, varY1=NULL, varY2=NULL, varY3=NULL, textlabelY=NULL,
textlabelY1=NULL, textlabelY2=NULL, textlabelY3=NULL, type=NULL, label=NULL,
MAR1=c(5,5,3,4), MAR2=c(5,5,3,8), MAR3=c(5,5,3,12), reg=FALSE, model=NULL,
outliers=FALSE, quant1=0.05, quant2=0.95, ResetPAR=TRUE, PAR=NULL, XLAB=NULL,
YLAB=NULL, YLAB1=NULL, YLAB2=NULL, YLAB3=NULL, XLIM=NULL, YLIM=NULL, YLIM1=NULL,
YLIM2=NULL, YLIM3=NULL, CEX=1.2, FONTLAB=2, CEXLAB=1.5, COLOR=NULL,
COLORR=NULL, PCH=NULL, lty=NULL, ltyL=NULL, lwd=2.5, lwdL=1, LEGEND=NULL,
MTEXT= NULL, TEXT=NULL, file="Output.txt")
```

Arguments

`data`	Data file.
`varX`	Quantitative independent variable.
`varY`	Dependent variable.
`varY1`	First additional variable.

`varY2`	Second additional variable.
`varY3`	Third additional variable.
`textlabelY`	Variable with the text labels for varY.
`textlabelY1`	Variable with the text labels for varY1.
`textlabelY2`	Variable with the text labels for varY2.
`textlabelY3`	Variable with the text labels for varY3.
`type`	Character string giving the type of plot desired. It must be as many as the number of variables Y. The following values are possible: "p" for points, "l" for lines, "b" for both points and lines (default), "c" for empty points joined by lines, "o" for overplotted points and lines, "s" and "S" for stair steps and "h" for histogram-like vertical lines. Finally, "n" does not produce any points or lines.
`label`	It allows to specify the characteristics of the text labels with the function text.
`MAR1`	A numeric vector with the format c(down, left, up, right) that defines the lines of the margins of the scatter plot when adding varY1.
`MAR2`	A numeric vector with the format c(down, left, up, right) that defines the lines of the margins of the scatter plot when adding varY1 and varY2.
`MAR3`	A numeric vector with the format c(down, left, up, right) that defines the lines of the margins of the scatter plot when adding varY1, varY2 and varY3.
`reg`	If TRUE a regression model is performed.
`model`	Regression model: "Linear" (default), "Log", "S-curve", "Power", "Exp", "Quadratic", "Cubic", "Inverse". It is not considered the model in those cases in which there is the logarithm that apply to any of the variables, if any value of the variable, which applies the logarithm, is zero or negative. The inverse model is not calculated if any value of the independent variable is zero. It must be as many as the number of variables Y.
`outliers`	If it is TRUE, the outliers are removed using the selected regression model.
`quant1`	Quantile of the lower end to the elimination of outliers.
`quant2`	Quantile of the upper end to the elimination of outliers.
`ResetPAR`	If it is FALSE, the default condition of the function PAR is not placed and maintained those defined by the user in previous graphics.
`PAR`	It accesses the function PAR that allows to modify many different aspects of the graph.
`XLAB`	Legend of the X axis.
`YLAB`	Legend of the Y ax1s.
`YLAB1`	Legend of the Y1 ax1s.
`YLAB2`	Legend of the Y2 ax1s.
`YLAB3`	Legend of the Y3 ax1s.
`XLIM`	Limits of X axis.
`YLIM`	Limits of Y axis.
`YLIM1`	Limits of Y1 axis.

`YLIM2`	Limits of Y2 axis.
`YLIM3`	Limits of Y3 axis.
`CEX`	Size of the symbols.
`FONTLAB`	Family font of the legends.
`CEXLAB`	Size of the legends.
`COLOR`	Color of the symbols. It must be as many as the number of variables Y.
`COLORR`	Color of the line of the regression model. It must be as many as the number of variables Y.
`PCH`	Graphic symbol (see the description of the same argument in the function F1). It must be as many as the number of variables Y.
`lty`	Type of the regression line (see the description of the same argument in the function F1). It must be as many as the number of variables Y.
`ltyL`	Type of the line chart (see figure of the argument *lty* in the function F1). It must be as many as the number of variables Y.
`lwd`	Line width of the regression line relative to the default (default=1), so 2 is twice as wide.
`lwdL`	Line width of the chart relative to the default (default=1), so 2 is twice as wide.
`LEGEND`	It allows to modify the legend of the graph.
`MTEXT`	It allows to add text on the margins of the graph.
`TEXT`	It allows to add text in any area of the inner part of the graph.
`file`	TXT FILE. If the argument *reg=TRUE* a TXT file is saved with the information of the regressions.

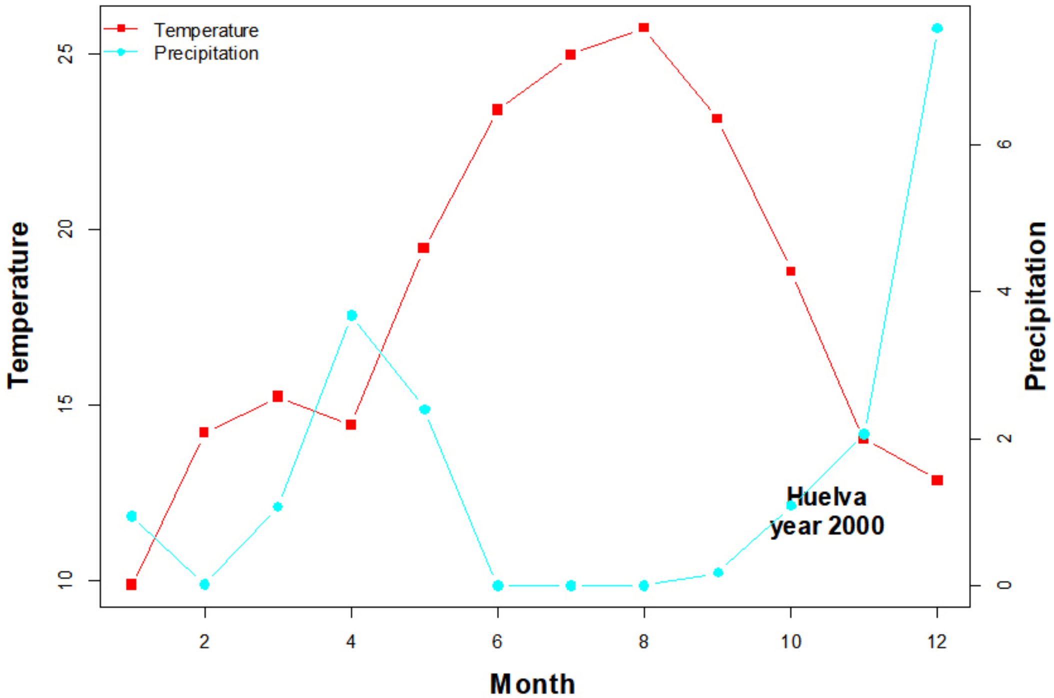
Details

FUNCTIONS

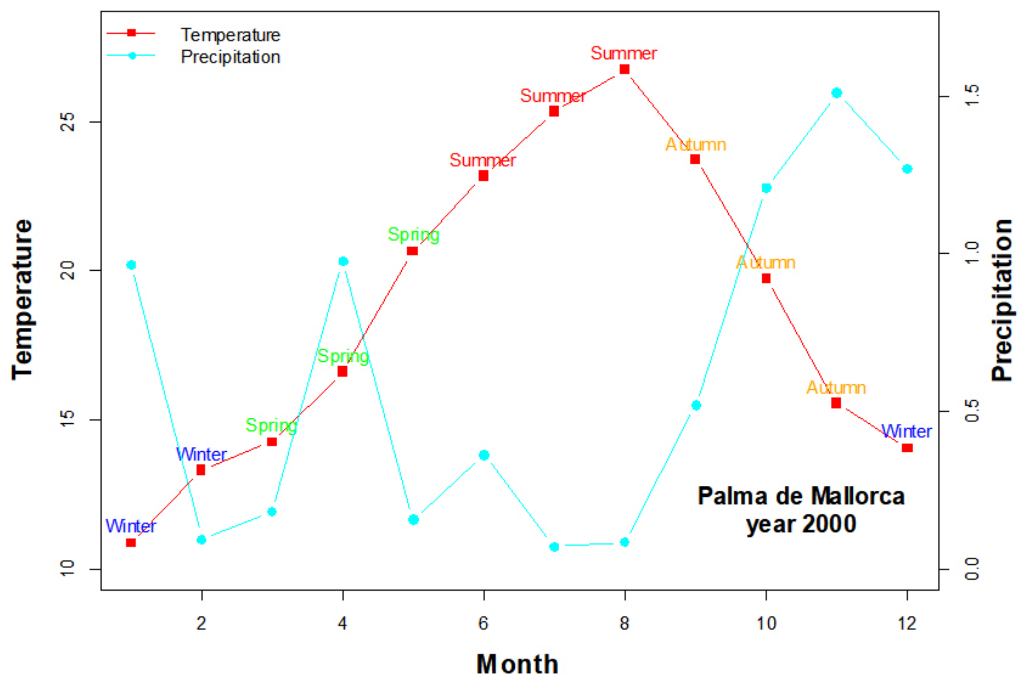
The plot is performed with the function plot.default of base graphics package and the linear regression with the function lm of base stats package, the function lillie.test of the package nortest (Gross, 2013) to perform the test of Normality Kolmogorov-Smirnov with Lilliefors'correction, the function dwtest of the package lmtest (Hothorn et al., 2013) to analyze the autocorrelation with the test and the Durbin-Watson statistic function bptest of the package lmtest (Hothorn et al., 2013) to perform the Breusch-Pagan test of homoscedasticity.

EXAMPLES

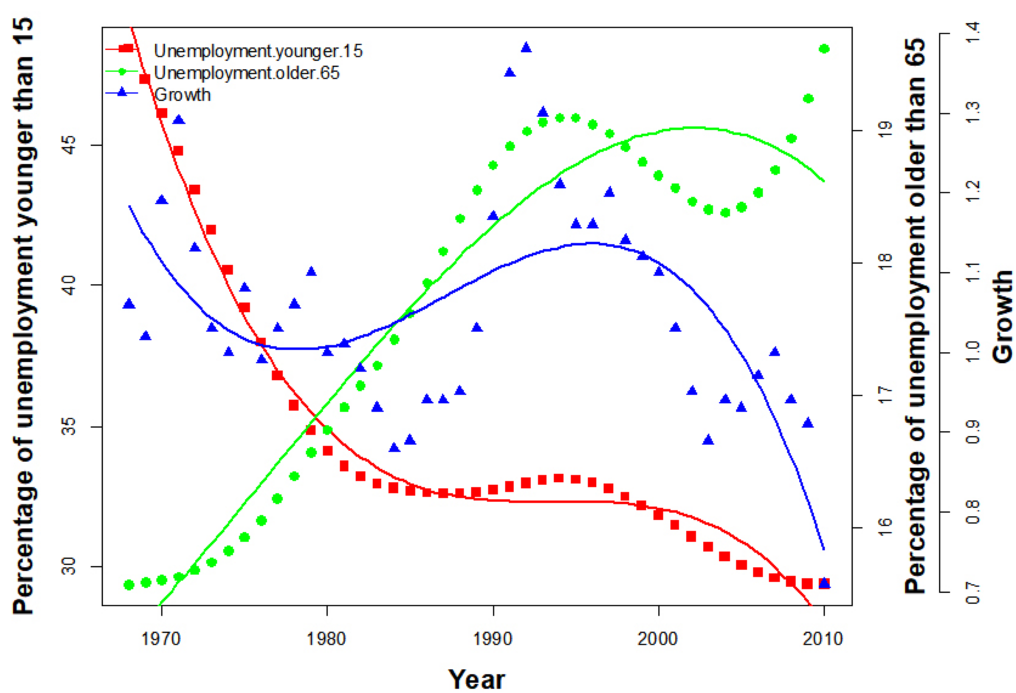
Example 1 Monthly temperature in Huelva (Spain) in the year 2000.



Example 2 Monthly temperature in Palma de Mallorca (Spain) in the year 2000. Text labels are assigned to the points with the argument *textlabel="Season"*. Moreover, a different color is assigned to each text label using a variable with colors.



Example 3 A cubic regression line is added with the arguments *reg=TRUE* and *model*. It is shown the relationships between year and the percentages of unemployment older than 65 and younger than 15, and the growth rate in North America from 1968 to 2010.



Value

Line charts and scatterplot with or without linear regression with additional axes are obtained.

References

Durbin, J. & Watson G.S. (1951) Testing for serial correlation in least squares regression. *Biometrika*, **38**, 159-171.

Gross, J. (2013) Tests for Normality. R package version 1.0-2. Available at: https://CRAN.R-project.org/package=nortest.

Hothorn, T. et al., (2013) Testing Linear Regression Models. R package version 0.9-33. Available at: https://CRAN.R-project.org/package=lmtest.

Examples

```
## Not run:

#Example 1

data(Z13)

data<-subset(Z13,(City == "Huelva") &  (Year == 2000))

F84(data=data, varX="Month", varY="Temperature",  varY1="Precipitation",
TEXT = c("x = 10.5", "y=12", "labels='Huelva\nyear 2000'", "font=2", "cex=1.3"))

#Example 2

data(Z13)

data<-subset(Z13,(City=="Palma de Mallorca") & (Year==2000))

colorlabel<-as.character(data[,"Color"])

F84(data=data, varX="Month", varY="Temperature", varY1="Precipitation",
textlabelY="Season", label = c("pos=3" , "col=colorlabel"), YLIM=c(10,28),
YLIM1=c(0,1.7), TEXT = c("x=10.5", "y=12", "labels='Palma de Mallorca\nyear 2000'",
"font=2", "cex=1.3"))

#Example 3

data(Z3)

data<-subset(Z3,(Region== "North America"))

F84(data=data, varX="Year", varY="Unemployment.younger.15",
varY1="Unemployment.older.65", varY2="Growth", type=c("p","p","p"),
YLAB="Percentage of unemployment younger than 15",
YLAB1="Percentage of unemployment older than 65", reg="TRUE",
model=c("Cubic","Cubic","Cubic"))

## End(Not run)
```

F85 *ADDITIONAL AXES IN LINE CHARTS AND SCATTER PLOTS FOR VARIABLE X QUALITATIVE*

Description

It is possible to add up to 3 additional axes to line charts and scatterplots with or without text labels, and a regression model.

Usage

```
F85(data, FactorX, varY, varY1=NULL, varY2=NULL, varY3=NULL, method="mean",
dev="sd", type=NULL, MAR1=c(5,5,3,4), MAR2=c(5,5,3,8), MAR3=c(5,5,3,12),
ResetPAR=TRUE, PAR=NULL, order=NULL, OrderCat=NULL, LabelCat=NULL,
XLAB=NULL, YLAB=NULL, YLAB1=NULL, YLAB2=NULL,YLAB3=NULL, XLIM=NULL, YLIM=NULL,
YLIM1=NULL, YLIM2=NULL, YLIM3=NULL, CEX=1.4, FONTLAB=2, CEXLAB=1.5, COLOR=NULL,
COLORI="black", PCH=NULL, ltyL=NULL, lwdL=1, LEGEND=NULL, MTEXT= NULL, TEXT=NULL)
```

Arguments

`data`	Data file.
`FactorX`	Qualitative independent variable.
`varY`	Dependent variable.
`varY1`	First additional variable.
`varY2`	Second additional variable.
`varY3`	Third additional variable.
`method`	If it is not NULL, the average of each category of the independent variable *FactorX* is estimated with the "mean" or the "median".
`dev`	If the argument *method* is not NULL, the error bars may be estimated using the standard deviation ("sd") or the standard error ("se").
`type`	Character string giving the type of plot desired. It must be as many as the number of variables Y. The following values are possible: "p" for points, "l" for lines, "b" for both points and lines (default), "c" for empty points joined by lines, "o" for overplotted points and lines, "s" and "S" for stair steps and "h" for histogram-like vertical lines. Finally, "n" does not produce any points or lines.
`MAR1`	A numeric vector with the format c(down, left, up, right) that defines the lines of the margins of the scatter plot when adding varY1.
`MAR2`	A numeric vector with the format c(down, left, up, right) that defines the lines of the margins of the scatter plot when adding varY1 and varY2.
`MAR3`	A numeric vector with the format c(down, left, up, right) that defines the lines of the margins of the scatter plot when adding varY1, varY2 and varY3.
`ResetPAR`	If it is FALSE, the default condition of the function PAR is not placed and maintained those defined by the user in previous graphics.

`PAR`	It accesses the function PAR that allows to modify many different aspects of the graph.
`order`	If it is NULL the categories are ordered as found in the variable *FactorX*, if it is "increasing" are ordered from lesser to greater median or mean according to the method selected in the argument *method*, if it is "decreasing" are ordered from greater to lesser median or mean, if it is "alhaAZ" are ordered from A to Z and if it is "alphaZA" from Z to A.
`OrderCat`	It allows to specify a vector with the order in which the categories are shown. If this argument is specified, the argument *order* is not taken into account.
`LabelCat`	It allows to specify a vector with the names of the categories.
`XLAB`	Legend of the X axis.
`YLAB`	Legend of the Y ax1s.
`YLAB1`	Legend of the Y1 ax1s.
`YLAB2`	Legend of the Y2 ax1s.
`YLAB3`	Legend of the Y3 ax1s.
`XLIM`	Limits of X axis.
`YLIM`	Limits of Y axis.
`YLIM1`	Limits of Y1 axis.
`YLIM2`	Limits of Y2 axis.
`YLIM3`	Limits of Y3 axis.
`CEX`	Size of the symbols.
`FONTLAB`	Family font of the legends.
`CEXLAB`	Size of the legends.
`COLOR`	Color of the symbols. It must be as many as the number of variables Y.
`COLORI`	Color of the error bars.
`PCH`	Graphic symbol (see the description of the same argument in the function F1). It must be as many as the number of variables Y.
`ltyL`	Type of the line chart (see figure of the argument *lty* in the function F1). It must be as many as the number of variables Y.
`lwdL`	Line width of the chart relative to the default (default=1), so 2 is twice as wide.
`LEGEND`	It allows to modify the legend of the graph.
`MTEXT`	It allows to add text on the margins of the graph.
`TEXT`	It allows to add text in any area of the inner part of the graph.

Details

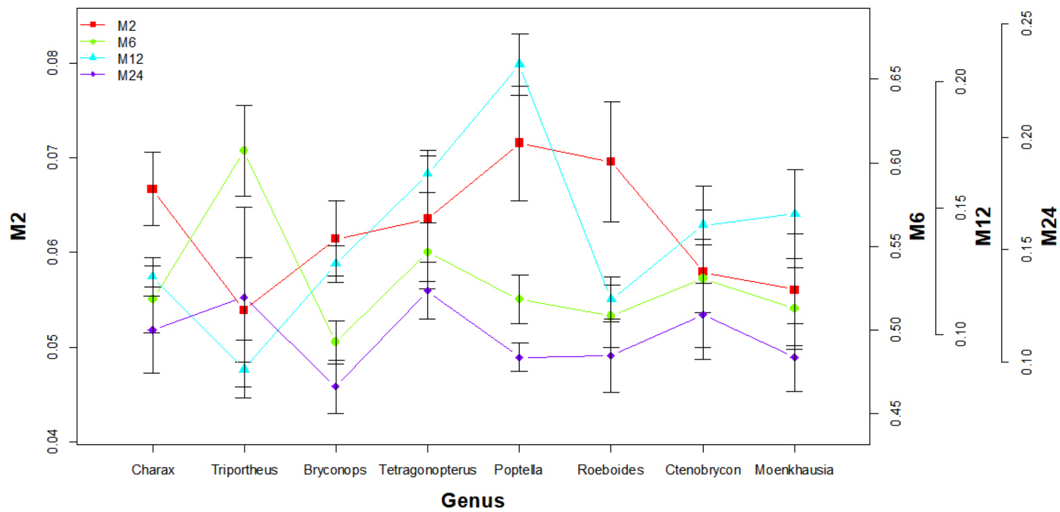
FUNCTIONS

The plot is performed with the functions boxplot, points and arrows of base graphics package.

EXAMPLE

For the examples, morphometric data of freshwater fishes, as the distance from the origin of the dorsal fin to the origin of the anal fin (M13), the length of the dorsal fin base (M12), body height

(M11), etc., are used. For details see Guisande et al. (2010). The next figure shows the mean values and standard deviation of several morphometric variables for each genus.



Value

Line charts and scatterplot with or without linear regression with additional axes are obtained.

References

Guisande, C., Manjarrés-Hernández, A., Pelayo-Villamil, P., Granado-Lorencio, C., Riveiro, I., Acuña, A., Prieto-Piraquive, E., Janeiro, E., Matías, J.M., Patti, C., Patti, B., Mazzola, S., Jiménez, S., Duque, V. & Salmerón, F. (2010) IPez: An expert system for the taxonomic identification of fishes based on machine learning techniques. *Fisheries Research*, 102, 240-247.

Examples

```
## Not run:

data(Z1)

F85(data=Z1, FactorX="Genus", varY="M2", varY1="M6", varY2="M12", varY3="M24")

## End(Not run)
```

F86 *ZOOM PLOT*

Description

This function makes a zoom in a scatterplot.

Usage

```
F86(data, varY, varX, rylim, rxlim, ResetPAR=TRUE, PAR=NULL, XLAB=NULL, YLAB=NULL,
XLIM=NULL, YLIM=NULL, MAIN=NULL, titlepos=NA, COLOR="tomato", PCH=16, ZOOM=NULL,
MTEXT=NULL, TEXT=NULL)
```

Arguments

`data`	Data file.
`varY`	Dependent variable.
`varX`	Quantitative independent variable.
`rylim`	Limits for the expanded plot of the Y axis.
`rxlim`	Limits for the expanded plot of the X axis.
`ResetPAR`	If it is FALSE, the default condition of the function PAR is not placed and maintained those defined by the user in previous graphics.
`PAR`	It accesses the function PAR that allows to modify many different aspects of the graph.
`XLAB`	Legends of the X axis.
`YLAB`	Legends of the Y axis.
`XLIM`	Limits of the X axis.
`YLIM`	Limits of the Y axis.
`MAIN`	Main title of the plot.
`titlepos`	Horizontal position of the main title.
`COLOR`	Color of the symbols.
`PCH`	Graphic symbol (see the description of the same argument in the function F1). It must be as many as the number of variables Y.
`ZOOM`	It accesses the function zoomInPlot that allows to modify many different aspects of the graph.
`MTEXT`	It allows to add text on the margins of the graph.
`TEXT`	It allows to add text in any area of the inner part of the graph.

Details

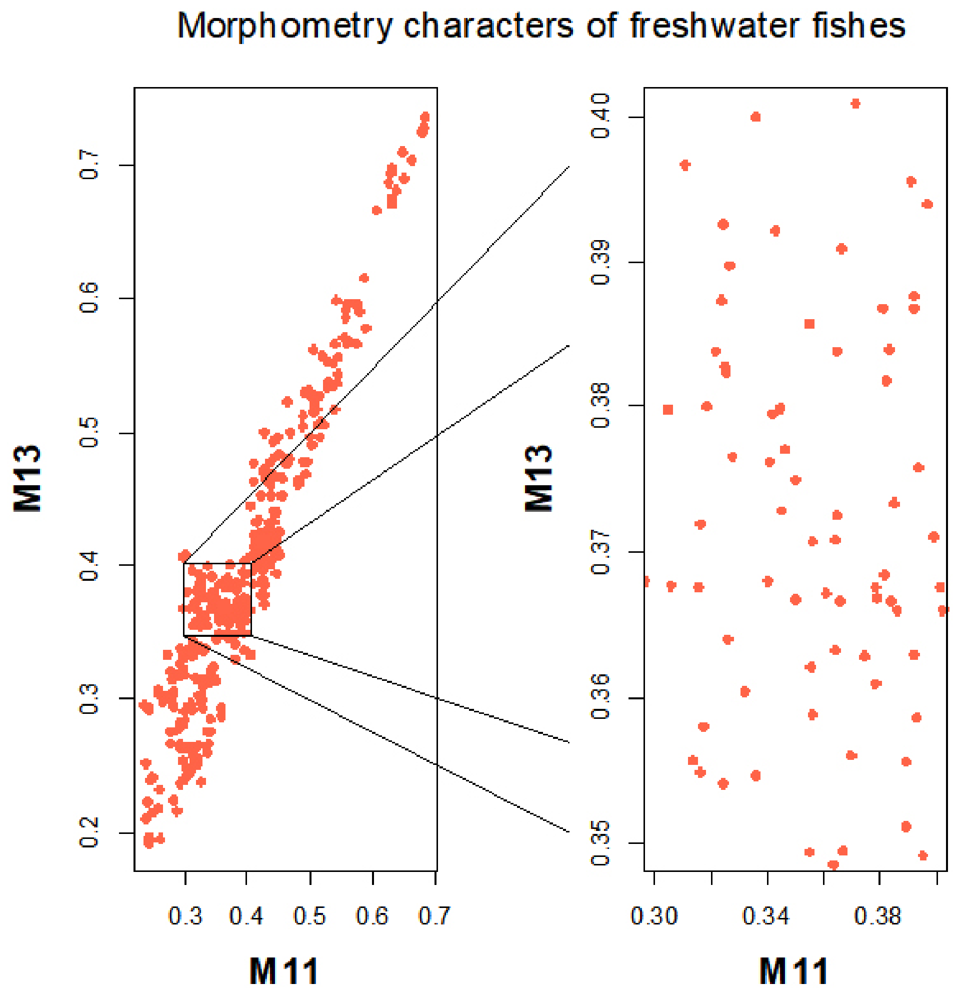
FUNCTIONS

The plot is performed with the function zoomInPlot of the package plotrix (Lemon et al., 2017).

EXAMPLE

For the examples, morphometric data of freshwater fishes, as the distance from the origin of the dorsal fin to the origin of the anal fin (M13), the length of the dorsal fin base (M12), body height (M11), etc., are used. For details see Guisande et al. (2010).

The next figure shows the relationship between the variables M11 and M13 and a zoom in an inner area.



Value

It is depicted a scatterplot and a second graph with a zoom of the first graph.

References

Lemon, J., Bolker, B., Oom, S., Klein, E., Rowlingson, B., Wickham, H., Tyagi, A., Eterradossi, O., Grothendieck, G., Toews, M., Kane, J., Turner, R., Witthoft, C., Stander, J., Petzoldt, T., Duursma, R., Biancotto, E., Levy, O., Dutang, C., Solymos, P., Engelmann, R., Hecker, M., Steinbeck, F., Borchers, H., Singmann, H., Toal, T. & Ogle, D. (2017) Various plotting functions. R package version 3.7. Available at: https://CRAN.R-project.org/package=plotrix.

Guisande, C., Manjarrés-Hernández, A., Pelayo-Villamil, P., Granado-Lorencio, C., Riveiro, I., Acuña, A., Prieto-Piraquive, E., Janeiro, E., Matías, J.M., Patti, C., Patti, B., Mazzola, S., Jiménez, S., Duque, V. & Salmerón, F. (2010) IPez: An expert system for the taxonomic identification of fishes based on machine learning techniques. *Fisheries Research*, 102, 240-247.

Examples

```
## Not run:

data(Z1)

F86(data = Z1 , varY = "M13" , varX="M11", rylim=c(0.35,0.4), rxlim=c(0.3,0.4),
MAIN="Morphometry characters of freshwater fishes", titlepos=0.26)
## End(Not run)
```

F87 *SPIDER PLOT*

Description

A spider plot is depicted.

Usage

```
F87(data, var, cat, shade=TRUE, type="p", ResetPAR=TRUE,  PAR=NULL, SPIDER=NULL,
COLOR=NULL, LIMITS=NULL, PCH=NA, LTY=1, AXISP=2, POSL=1.15, MAIN=NULL, LEG=TRUE,
LEGEND=NULL, MTEXT= NULL, TEXT=NULL)
```

Arguments

data	Data file.
var	Variables.
cat	Variable with the categories.
shade	If it is TRUE the polygons are shaded.
type	It may be radial lines ("r"), a polygon ("p"), symbols ("s") or some combination of these. If lengths is a matrix and *type* is a vector, each row of lengths can be displayed differently.
ResetPAR	If it is FALSE, the default condition of the function PAR is not placed and maintained those defined by the user in previous graphics.
PAR	It accesses the function PAR that allows to modify many different aspects of the graph.
SPIDER	It accesses the function radial.plot that allows to modify many different aspects of the graph.
COLOR	It allows to modify the colors of the spider plot. It must be as many as different categories of the variable *cat*.
LIMITS	Limits of axes.
PCH	Graphic symbol (see the description of the same argument in the function F1).
LTY	Type of line (see the description of the same argument in the function F1).
AXISP	Position of the axis (1, 2, 3 or 4).

POSL	Position of the labels. A highest value means more distant from the plot.
MAIN	Main title of the plot.
LEG	If it is TRUE the legend is shown.
LEGEND	It allows to modify the legend of the plot.
MTEXT	It allows to add text on the margins of the graph.
TEXT	It allows to add text in any area of the inner part of the graph.

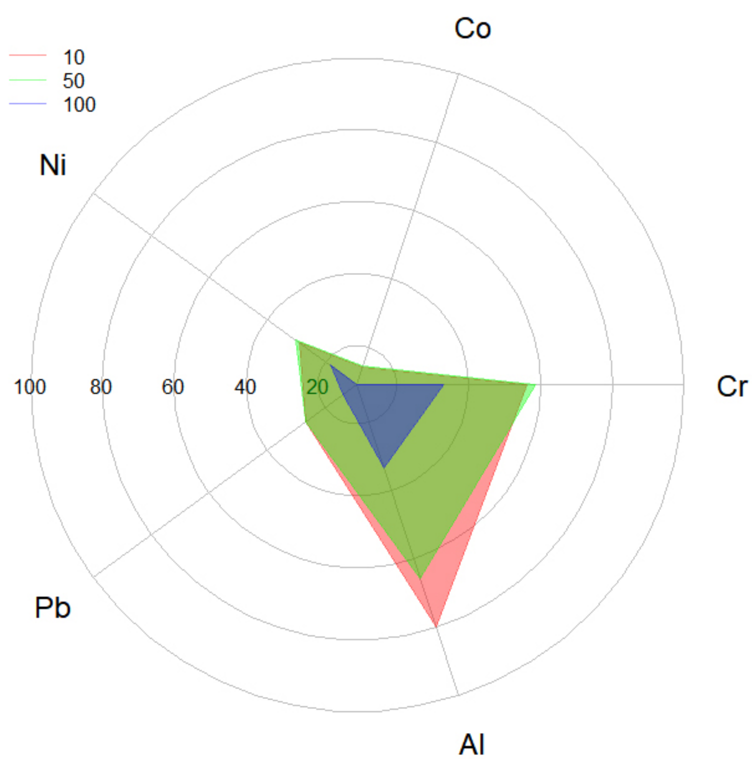
Details

FUNCTIONS

The plot is performed with the function radial.plot of the package plotrix (Lemon et al., 2017).

EXAMPLE

The concentration of metals in the sediment of one of the Yahuarkaka lakes (Leticia, Colombia) is used as example. It is selected only three depths.



Value

It is depicted a spider plot.

References

Lemon, J., Bolker, B., Oom, S., Klein, E., Rowlingson, B., Wickham, H., Tyagi, A., Eterradossi, O., Grothendieck, G., Toews, M., Kane, J., Turner, R., Witthoft, C., Stander, J., Petzoldt, T., Duursma, R., Biancotto, E., Levy, O., Dutang, C., Solymos, P., Engelmann, R., Hecker, M., Steinbeck, F., Borchers, H., Singmann, H., Toal, T. & Ogle, D. (2017) Various plotting functions. R package version 3.7. Available at: https://CRAN.R-project.org/package=plotrix.

Examples

```
## Not run:

data(Z21)
data<-subset(Z21,(Depth==10) |  (Depth==50) |  (Depth==100))
F87(data=data, var=c("Cr","Co","Ni", "Pb", "Al"), cat="Depth")

## End(Not run)
```

F88 *BUBBLE MAP*

Description

An interactive bubble map is depicted.

Usage

```
F88(data, var, lon, lat, tooltip, legend="bottomright", title=NULL,
color="white", colscale=rev(heat.colors(100)), breaks=10, opacity=0.9,
fillOpacity=0.7, radius=8, stroke=FALSE)
```

Arguments

data	Data file.
var	This variable defines the color gradient of the bubbles.
lon	Variable with the longitude.
lat	Variable with the latitude.
tooltip	Variables displayed when moving the mouse over the bubble.
legend	Position of the legend.
title	Title of the legend.
color	Color of the stroke.
colscale	Color of the legend.
breaks	Number of breaks of the legend.
opacity	Stroke opacity.
fillOpacity	Fill opacity.
radius	Radius of the bubbles.
stroke	Whether to draw stroke aound the bubbles.

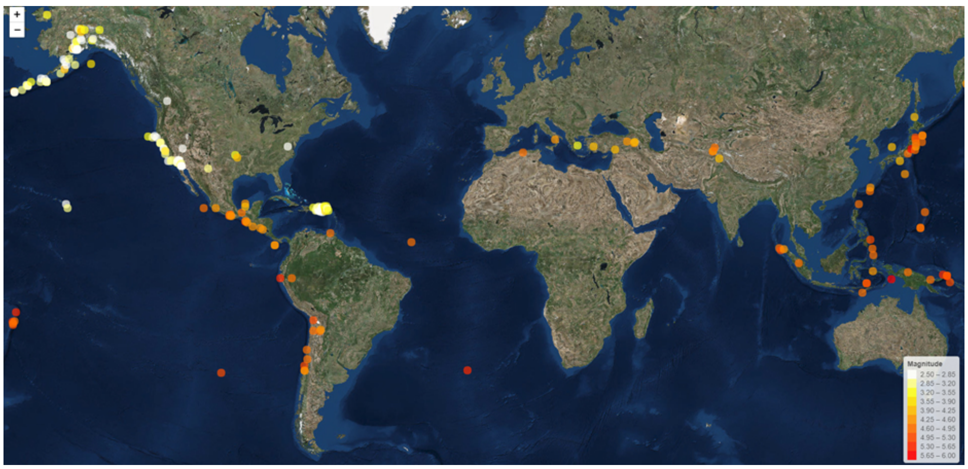
Details

FUNCTIONS

The plot is performed with the functions leaflet of the package leaflet (Cheng, 2018) and HTML of the package htmltools (Cheng, 2017).

EXAMPLE

Earthquakes around the world.



Value

It is depicted an interactive bubble map.

References

Cheng, J. (2017) Tools for HTML. R package version 0.3.6. Available at: `https://CRAN.R-project.org/package=htmltools`.

Cheng, J. (2018) Create Interactive Web Maps with the JavaScript 'Leaflet' Library. R package version 2.0.0. Available at: `https://CRAN.R-project.org/package=leaflet`.

Examples

```
## Not run:

data(Z29)

F88(data=Z29, var="Magnitude", lon="Longitude", lat="Latitude",
tooltip=c("Magnitude", "Depth"))
## End(Not run)
```

F89 *GROUPED BOXPLOT*

Description

A grouped boxplot is a boxplot where each category is subdivided in several groups.

Usage

```
F89(data, varY, varX, group, jitter=FALSE, mar=c(4,4.5,3,1), ResetPAR=TRUE,
PAR=NULL, OrderCatX=NULL, LabelCatX=NULL, OrderGroup=NULL, LabelGroup=NULL,
COLOR=NULL, BOXWEX=0.4, XCEX=1, XLAS=1, XFONT=2, XTICK=TRUE, XCOLOR="grey",
XLTY=1, BOXPLOT=NULL, LEGEND=NULL, MTEXT=NULL, TEXT=NULL)
```

Arguments

`data`	Data file.
`varY`	Dependent variable.
`varX`	Variable with the categories.
`group`	Variable for the groups.
`jitter`	If it is TRUE points are added with the function jitter of the base package.
`mar`	Margins of the boxplot.
`ResetPAR`	If it is FALSE, the default condition of the function PAR is not placed and maintained those defined by the user in previous graphics.
`PAR`	It accesses the function PAR that allows to modify many different aspects of the graph.
`OrderCatX`	It allows to specify a vector with the order in which the categories of the variable *varX* are shown.
`LabelCatX`	It allows to specify a vector with the names of the categories of the variable *varX*.
`OrderGroup`	It allows to specify a vector with the order in which the categories of the variable *group* are shown.
`LabelGroup`	It allows to specify a vector with the names of the categories of the variable *group*.
`COLOR`	Vector with the color of the categories or just one color for all categories of the variable *group*.
`BOXWEX`	A scale factor to be applied to all boxes. It is useful when there are many groups, because this argument allows to make the boxes narrower.
`XCEX`	Size of the text in the X axis.
`XLAS`	Axis label orientation: 0 is parallel to the shaft, 1 is horizontal, 2 is perpendicular, and 3 is vertical.

XFONT	Font type of the text in the X axis. The value 1 is a normal type, 2 is written in bold, 3 is written in italics and 4 is written in italics and bold.
XTICK	If it is TRUE, ticks are added in the X axis.
XCOLOR	Color of the lines that divide the groups.
XLTY	It defines the type of lines that divide the groups: 0 No line, 1 Solid line, 2 Dashed line, 3 Dotted line, 4 Line of dots and dashes, 5 Dash line and 6 Double stripe.
BOXPLOT	It allows to specify the characteristics of the function boxplot.
LEGEND	It allows to include a legend to the graph.
MTEXT	It allows to add text on the margins of the graph.
TEXT	It allows to add text in any area of the inner part of the graph.

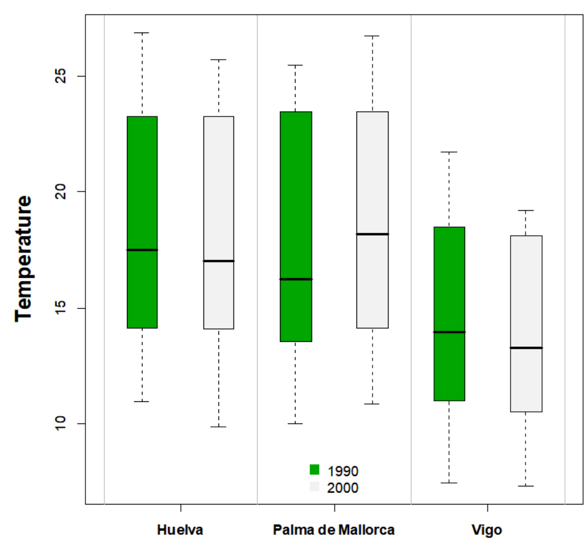
Details

FUNCTIONS

The plot is performed with the functions boxplot of the graphics package and jitter of the base package.

EXAMPLE

The data are monthly mean temperature for 1990 and 2000 in three cities in Spain: Huelva, Palma de Mallorca and Vigo. They were obtained from the Agencia Estatal de Meteorología of Spain `https://www.aemet.es/es/portada`.



Value

A grouped boxplot is obtained.

Examples

```
## Not run:

data(Z13)

F89(data=Z13, varY="Temperature", varX="City", group="Year",
LEGEND=c("x='bottom'", "legend=texto", "bty='n'", "pch=15", "pt.cex=1.5", "col=color"))


## End(Not run)
```

F90 *AREA PLOT FOR VARIABLE X QUANTITATIVE*

Description

It performs an area plot for variable Y quantitative.

Usage

```
F90(data, varY, varX, group, ymin=NULL, alpha=0.5, method="mean", ResetPAR=TRUE,
PAR=NULL, SYMBOLS=FALSE, XLAB=NULL, YLAB=NULL, XLIM=NULL, YLIM=NULL, COLOR=NULL,
BORDER=NULL, PCH=NULL, CEX=1, LEGEND=NULL, MTEXT= NULL, TEXT=NULL)
```

Arguments

`data`	Data file.
`varY`	Dependent variable.
`varX`	Quantitative independent variable.
`group`	Variable with the categories to be grouped.
`ymin`	Minimum value of the area for the variable *Y*.
`alpha`	Transparency of the areas. It ranges from 0 to 1. The value 0 is transparent and 1 is opaque.
`method`	The average of each category of the independent variable *varX* is estimated with the "mean" or the "median", if there are several values for each category of the variable.
`ResetPAR`	If it is FALSE, the default condition of the function PAR is not placed and maintained those defined by the user in previous graphics.
`PAR`	It accesses the function PAR that allows to modify many different aspects of the graph.
`SYMBOLS`	If it is TRUE, symbols are depicted.
`XLAB`	Legend of the X axis.
`YLAB`	Legend of the Y axis.
`XLIM`	Vector with the limits of the X axis.

`YLIM`	Vector with the limits of the Y axis.
`COLOR`	Color of the symbols. It must be as many as different categories of the variable *group*.
`BORDER`	Color of the borders of the area.
`PCH`	Graphic symbol (see the description of the same argument in the function F1). It must be as many as different categories of the variable *group*.
`CEX`	Size of the symbols.
`LEGEND`	It allows to modify the legend of the graph.
`MTEXT`	It allows to add text on the margins of the graph.
`TEXT`	It allows to add text in any area of the inner part of the graph.

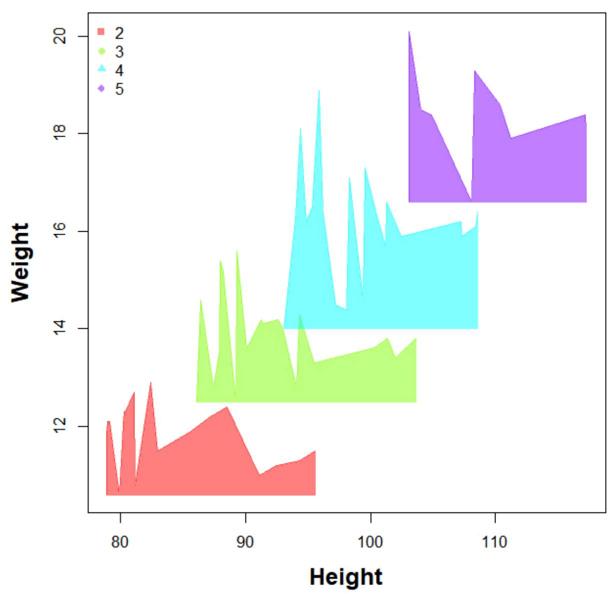
Details

FUNCTIONS

The plot is performed with the functions boxplot and points of base graphics package. For further details see Guisande & Vammonde (2012).

EXAMPLE

The example is the heigth and weight of chidren of different ages.



References

Guisande, C. & Vaamonde, A. (2012) *Gráficos estadísticos y mapas con R*. Ediciones Díaz de Santos, Madrid, 367 pp.

Examples

```
## Not run:

data(Z14)

F90(data=Z14, varY="Weight", varX="Height", group="Age")

## End(Not run)
```

F91 *AREA PLOT FOR VARIABLE X QUALITATIVE*

Description

It performs an area plot for variable X qualitative.

Usage

```
F91(data, varY, FactorX, group, ymin=NULL, alpha=0.5, method="mean", ResetPAR=TRUE,
PAR=NULL, order=NULL, OrderCat=NULL, LabelCat=NULL, SYMBOLS=FALSE, XLAB=NULL,
YLAB=NULL, XLIM=NULL, YLIM=NULL, COLOR=NULL, BORDER=NULL,PCH=NULL, CEX=1, LEGEND=NULL,
MTEXT= NULL, TEXT=NULL)
```

Arguments

`data`	Data file.
`varY`	Dependent variable.
`FactorX`	Qualitative independent variable.
`group`	Variable with the categories to be grouped.
`ymin`	Minimum value of the area for the variable *Y*.
`alpha`	Transparency of the areas. It ranges from 0 to 1. The value 0 is transparent and 1 is opaque.
`method`	The average of each category of the independent variable *FactorX* is estimated with the "mean" or the "median", if there are several values for each category of the variable.
`ResetPAR`	If it is FALSE, the default condition of the function PAR is not placed and maintained those defined by the user in previous graphics.
`PAR`	It accesses the function PAR that allows to modify many different aspects of the graph.
`order`	If it is NULL the categories are ordered as found in the variable *FactorX*, if it is "increasing" are ordered from lesser to greater median or mean according to the method selected in the argument *method*, if it is "decreasing" are ordered from greater to lesser median or mean, if it is "alhaAZ" are ordered from A to Z and if it is "alphaZA" from Z to A.

`OrderCat`	It allows to specify a vector with the order in which the categories are shown. If this argument is specified, the argument *order* is not taken into account.
`LabelCat`	It allows to specify a vector with the names of the categories.
`SYMBOLS`	If it is TRUE, symbols are depicted.
`XLAB`	Legend of the X axis.
`YLAB`	Legend of the Y axis.
`XLIM`	Vector with the limits of the X axis.
`YLIM`	Vector with the limits of the Y axis.
`COLOR`	Color of the symbols. It must be as many as different categories of the variable *group*.
`BORDER`	Color of the borders of the area.
`PCH`	Graphic symbol (see the description of the same argument in the function F1). It must be as many as different categories of the variable *group*.
`CEX`	Size of the symbols.
`LEGEND`	It allows to modify the legend of the graph.
`MTEXT`	It allows to add text on the margins of the graph.
`TEXT`	It allows to add text in any area of the inner part of the graph.

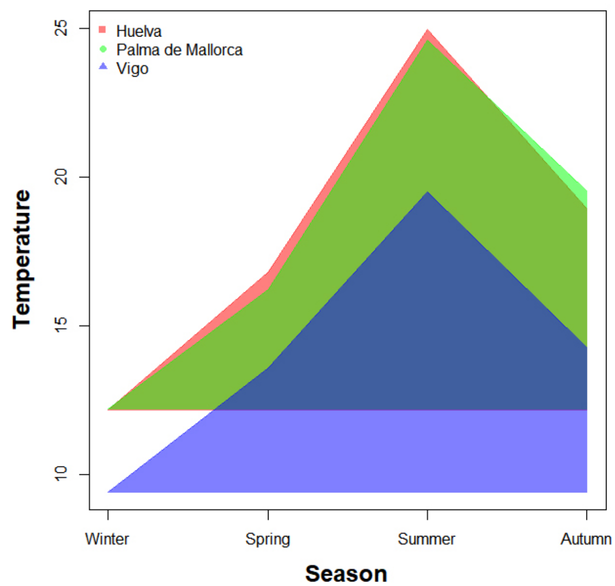
Details

FUNCTIONS

The plot is performed with the functions boxplot and points of base graphics package. For further details see Guisande & Vammonde (2012).

EXAMPLE

The example is the temperature in three cities of Spain over the seasons.



Value

An area plot for variable X qualitativeis is depicted.

References

Guisande, C. & Vaamonde, A. (2012) *Gráficos estadísticos y mapas con R*. Ediciones Díaz de Santos, Madrid, 367 pp.

Examples

```
## Not run:

data(Z13)

F91(data=Z13, varY="Temperature", FactorX="Season", group="City")

## End(Not run)
```

F92 *COMBINED BOXPLOTS AND BEANPLOTS*

Description

It performs a graph combining boxplots and beanplots.

Usage

```
F92(data, varY, varX, order=NULL, jitterBox=FALSE, jitterBean=TRUE,
line=TRUE, dist=0.2, boxwex=0.2, maxwidth=0.3, ResetPAR=TRUE, PAR=NULL,
OrderCat=NULL, LabelCat=NULL, side="no", beanlines="median", what=c(0,1,0,0),
border="black", PCH=15, CEX=1.8, COLOR=NULL, BOXPLOT=NULL, BEANPLOT=NULL,
YLIM=NULL, XLIM=NULL, XLAB=NULL, YLAB=NULL, LEGEND=NULL, MTEXT= NULL, TEXT=NULL)
```

Arguments

`data`	Data file.
`varY`	Dependent variable.
`varX`	Variable with the categories.
`order`	If it is NULL the categories are ordered as found in the variable *varX*, if it is "increasing" are ordered from lesser to greater median, if it is "decreasing" are ordered from greater to lesser median, if it is "alhaAZ" are ordered from A to Z and if it is "alphaZA" from Z to A.
`jitterBox`	If it is TRUE, points are added with the function jitter of the base package to the boxplots.
`jitterBean`	If it is TRUE, points are added with the function jitter of the base package to the beanplots.
`line`	If it is TRUE, a line is depicted.
`dist`	Distance between boxplots and beanplots.
`boxwex`	Width of boxplots.
`maxwidth`	Width of beanplots.
`ResetPAR`	If it is FALSE, the default condition of the function PAR is not placed and maintained those defined by the user in previous graphics.
`PAR`	It accesses the function PAR that allows to modify many different aspects of the graph.
`OrderCat`	It allows to specify a vector with the order in which the categories are shown. If this argument is specified, the argument *order* is not taken into account.
`LabelCat`	It allows to specify a vector with the names of the categories.
`side`	The side on which the beans are plot. Default is "no", for symmetric beans. The options "first", "second" and "both" are also supported.
`beanlines`	The method used for determining the average bean lines. Default is value "median", and other options are "mean" and "quantiles".
`what`	A vector of four booleans describing what to plot. In the following order, these booleans stand for the total average line, the beans, the bean average, and the beanlines. For example, *what=c(0,0,0,1)* produces a stripchart.
`border`	Color of the border around the bean.
`PCH`	Type of the symbol.
`CEX`	Size of the symbol.
`COLOR`	Vector with the color of the categories or just one color for all categories.

BOXPLOT	It allows to specify the characteristics of the function boxplot.
BEANPLOT	It allows to specify the characteristics of the function beanplot.
YLIM	Limits of *Y* axis.
XLIM	Limits of *X* axis.
XLAB	Legend of *X* axis.
YLAB	Legend of *Y* axis.
LEGEND	It allows to include a legend to the graph.
MTEXT	It allows to add text on the margins of the graph.
TEXT	It allows to add text in any area of the inner part of the graph.

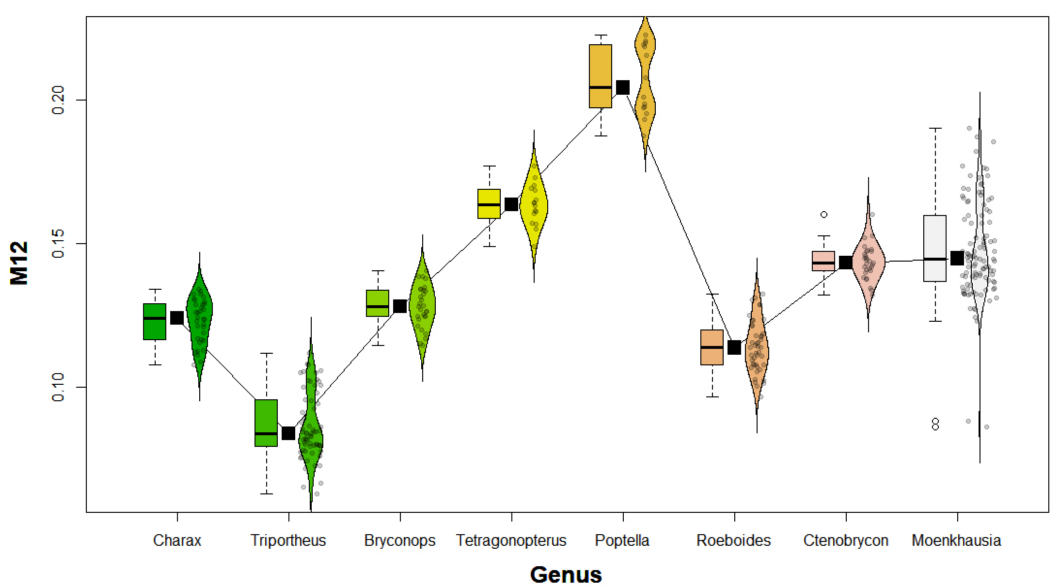
Details

FUNCTIONS

The boxplot is performed with the functions boxplot of the graphics package and jitter of the base package. The beanplot is performed with the function beanplot of the beanplot package (Kampstra, 2008; Kampstra, 2015). For further details see the help of the function beanplot and/or Guisande & Vammonde (2012).

EXAMPLES

For the examples, morphometric data of several fish species of Characiforms, as the length of the dorsal fin base (M12), body height (M11), etc., are used. For details see Guisande et al. (2010). It is shown the length of the dorsal fin base (M12) for all genera.



Value

A graph combining boxplots and beanplots is depicted.

References

Guisande, C., Manjarrés-Hernández, A., Pelayo-Villamil, P., Granado-Lorencio, C., Riveiro, I., Acuña, A., Prieto-Piraquive, E., Janeiro, E., Matías, J.M., Patti, C., Patti, B., Mazzola, S., Jiménez, S., Duque, V. & Salmerón, F. (2010) IPez: An expert system for the taxonomic identification of fishes based on machine learning techniques. *Fisheries Research*, 102, 240-247.

Kampstra, P. (2008). Beanplot: A Boxplot Alternative for Visual Comparison of Distributions. *Journal of Statistical Software, Code Snippets*, 28: 1-9.

Kampstra, P. (2015) Visualization via Beanplots (like Boxplot/Stripchart/Violin Plot). R package version 1.2. Available at: https://CRAN.R-project.org/package=beanplot.

Examples

```
## Not run:

data(Z1)

F92(data=Z1, varY="M12", varX="Genus")

## End(Not run)
```

F93 *Ishikawa DIAGRAM*

Description

It performs an Ishikawa diagram.

Usage

```
F93(data, cause, effect="Effect", title="Cause-and-Effect diagram",
cex=c(1.2,1.1,1.3,2), font=c(1,3,2,2), col.margin="transparent",
col.figure="transparent")
```

Arguments

`data`	Data file.
`cause`	Variables with the potential causes.
`effect`	A string character with the effect.
`title`	Main title of the diagram.
`cex`	A vector with 4 values indicating the size of the text in the following order: branches, causes, effect and title.
`font`	A vector with 4 values indicating the font of the text in the following order: branches, causes, effect and title.
`col.margin`	Color of the margin.
`col.figure`	Color inside the diagram.

Details

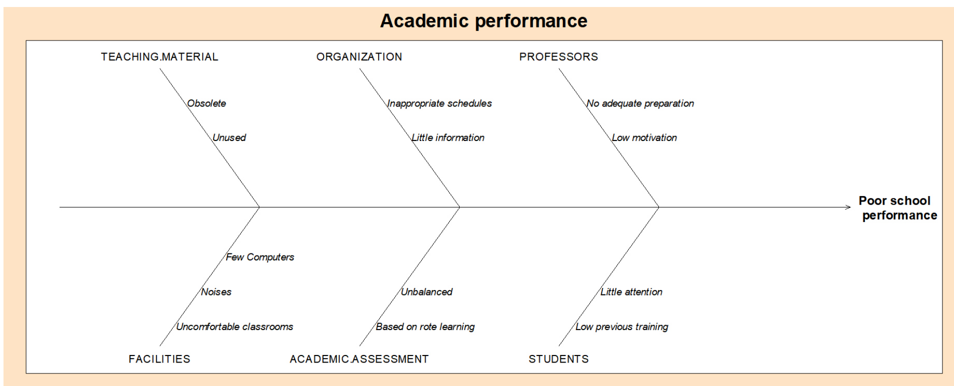
This representation is also known as cause-effect diagram or fishbone diagram. It consists of a simple graphical representation consisting of a horizontal line, which represents the problem to be analyzed, whose main effect is written to the right, and various lines in the form of fish thorns, which allow to describe the different causal elements. At the ends of these lines the different categories are indicated, and between those groups and the center line, the different possible causes associated with each one.

FUNCTIONS

The plot is performed with the function cause.and.effect of the package qcc (Scrucca, 2017). For further details see Guisande & Vammonde (2012).

EXAMPLE

The example consists in analyzing, the possible causes of the low academic performance of the students of a University



Value

An Ishikawa diagram is depicted.

References

Guisande, C. & Vaamonde, A. (2012) *Gráficos estadísticos y mapas con R*. Ediciones Díaz de Santos, Madrid, 367 pp.

Scrucca, L. (2017) Quality Control Charts. R package version 2.7. Available at: https://CRAN.R-project.org/package=qcc.

Examples

```
## Not run:
data(Z30)

F93(data=Z30, cause=c( "TEACHING.MATERIAL", "ORGANIZATION", "PROFESSORS", "FACILITIES",
"ACADEMIC.ASSESSMENT", "STUDENTS"), title="Academic performance",
effect="Poor school\n performance", col.margin="#FFE4C4FF", col.figure="white")

## End(Not run)
```

F94 *Pareto CHART*

Description

It performs an Pareto chart.

Usage

```
F94(data, defect, number, xlab=NULL, ylab="Frequency", ylab2="Cumulative percentage",
cumperc=seq(0, 100, by = 25),  ylim=NULL, main="Pareto chart", col=NULL)
```

Arguments

data	Data file.
defect	Variable with the name of the defects.
number	Variable with the observed number of each of the defects.
xlab	Legend of X-axis.
ylab	Legend of Y-axis
ylab2	Legend of Y-axis on the right side.
cumperc	A vector of percentage values to be used as tickmarks for the second Y-axis on the right side.
ylim	A numeric vector specifying the limits for the Y-axis.
main	Main title of the chart.
col	Color of the bars

Details

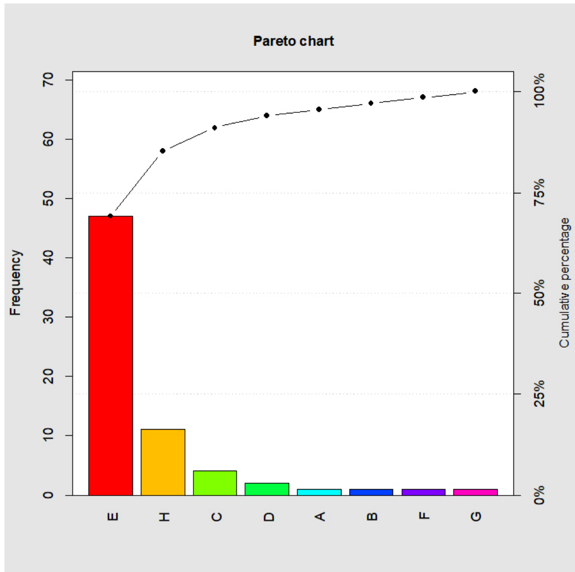
The purpose of the Pareto chart, in quality control, is to highlight the most important sources of defects, the highest occurring type of defect, the most frequent reasons for customer complaints, etc., among a set of factors.

FUNCTIONS

The plot is performed with the function pareto.chart of the package qcc (Scrucca, 2017). For further details see Guisande & Vammonde (2012).

EXAMPLE

The example consists in types of defects detected in the elaboration of a product and the observed number of each of these defects.



Value

An Pareto chart is depicted and a table with the descriptive statistics used to draw the Pareto chart.

References

Guisande, C. & Vaamonde, A. (2012) *Gráficos estadísticos y mapas con R*. Ediciones Díaz de Santos, Madrid, 367 pp.

Scrucca, L. (2017) Quality Control Charts. R package version 2.7. Available at: https://CRAN.R-project.org/package=qcc.

Examples

```
## Not run:

data(Z31)

F94(data=Z31, defect="Defect.Type", number="Number")

## End(Not run)
```

F95 *MSA TYPE I PLOTS*

Description

It performs three plots of Measurement System Analyses (MSA) type I: Run chart, histogram and tolerance chart.

Usage

```
F95(data, var, combined=TRUE, cgOut=TRUE, target, tolerance, ref.interval,
facCg, facCgk, n=0.2, type="b", col1="black", col2="cadetblue1", col3="black",
pch=16, xlim, ylim, conf.level=0.95, cex.val=1.5, main1, main2, main3)
```

Arguments

`data`	Data file.
`var`	Variable to be analyzed.
`combined`	If it is TRUE, the three plots are combined in only one.
`cgOut`	It it is TRUE, centralized Gage potential index (*Cg*) and the non-centralized Gage Capability index (*Cgk*) values are shown in a legend.
`target`	A numeric value giving the expected target value for the variable.
`tolerance`	Vector with two values: the lower and upper specification limits.
`ref.interval`	Numeric value giving the confidence intervall on which the calculation is based. By default it is based on 6 sigma methodology. Regarding the normal distribution this relates to pnorm(3) - pnorm(-3) which is exactly 99.73002 percent If the calculation is based on an other sigma value ref.interval needs to be adjusted. To give an example: If the sigma-level is given by 5.15 the ref.interval relates to pnorm(5.15/2)-pnorm(-5.15/2) which is exactly 0.989976 percent.
`facCg`	Numeric value as a factor for the calculation of the gage potential index. The default Value for facCg is 0.2.
`facCgk`	Numeric value as a factor for the calulation of the gage capability index. The default value for facCgk is 0.1.
`n`	Numeric value between 0 and 1 giving the percentage of the tolerance field (values between the upper and lower specification limits given by tolerance) where the values of the variable should be positioned. Limit lines will be drawn. Default value is 0.2.
`type`	Character string giving the type of plot desired. The following values are possible: "p" for points, "l" for lines, "b" for both points and lines, "c" for empty points joined by lines, "o" for overplotted points and lines, "s" and "S" for stair steps and "h" for histogram-like vertical lines. Finally, "n" does not produce any points or lines.
`col1`	Color of points and line of tolerance chart, when the three plots are not combined.
`col2`	Color of bars in the histogram, when the three plots are not combined.
`col3`	Color of points and line of run chart, when the three plots are not combined.
`pch`	Graphic symbol (see the description of the same argument in the function F1).
`xlim`	Limits of X-axis in run chart.
`ylim`	Limits of Y-axis in run chart.
`conf.level`	Confidence level for internal t.test checking the significance of the bias between target and mean of x. The default value is 0.95. The result of the t.test is shown in the histogram on the left side.

`cex.val`	Numeric value giving the size of the text in the legend
`main1`	Main title of tolerance chart, when the three plots are not combined.
`main2`	Main title of the histogram, when the three plots are not combined.
`main3`	Main title of run chart, when the three plots are not combined.

Details

The measurement systems analysis (MSA) type I are experiments or procedures designed to verify the correction of the measure. It is calculated the centralized Gage potential index (*Cg*) and the non-centralized Gage Capability index (*Cgk*). The index *Cg* is calculated as a quotient between a fraction, typically 0.2, of the amplitude of the tolerance interval or difference between the upper limit (*LS*) and the lower limit (*LI*) and a measurement of the displacement, generally the range in which 95.5% or 99.73% of the values are found. These percentages correspond to amplitudes of interval of 4 or 6 typical deviations (values k = 2 and k = 3 of a standard Normal variable). The majority of the measurements follow a Normal distribution in practice, but the corresponding quantites can be used instead of the afore mentioned k values, if it is another distribution. The value of the index (*Cg*) is any of these equations:

$$C_g = 0.2\frac{(Ls - LI)}{4s}$$

$$C_g = 0.2\frac{(Ls - LI)}{6s}$$

When there is bias, this must be subtracted from the numerator. The bias is calculated by repeatedly measuring a known magnitude exactly (a pattern), and subtracting the mean of the measurements (x_m) minus the exact quantity or standard measure (x_e):

$$Sesgo = |x_m - x_e|$$

$$C_{gk} = 0.2\frac{(Ls - LI - Sesgo)}{4s}$$

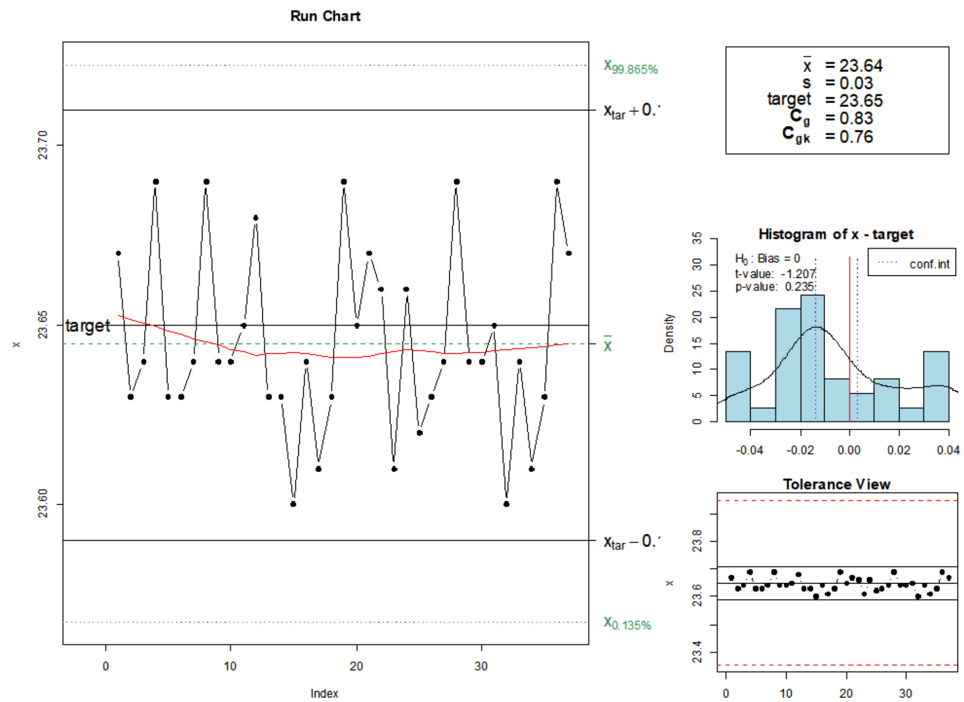
$$C_{gk} = 0.2\frac{(Ls - LI - Sesgo)}{6s}$$

FUNCTIONS

The plot is performed with the function cg of the package qualityTools (Roth, 2016).

EXAMPLE

The example consists in measurements of the inner diameter of two car parts in millimeters. The target diameter, which is intended to be achieved with the manufacture, is 23.65 mm, with tolerance limits *LI* = 23.35 and *LS* = 23.95.



Value

Three plots of Measurement System Analyses (MSA) type I are depicted: Run chart, histogram and tolerance chart. Furthermore the centralized Gage potential index (*Cg*) and the non-centralized Gage Capability index (*Cgk*) are calculated and displayed.

References

Roth, T. (2016) Statistical Methods for Quality Science. R package version 1.55. Available at: https://CRAN.R-project.org/package=qualityTools.

Examples

```
## Not run:
data(Z32)

F95(data=Z32, var="Part1", target = 23.65, tolerance = c(23.35, 23.95))

## End(Not run)
```

Description

It performs Shewhart charts, also called process-behavior charts, which are a statistical process control tool used to determine if a manufacturing or business process is in a state of controlfor quantitative or qualitative data.

Usage

```
F98(data, measurements, samples, sizes, type="xbar", subset=NULL,
center, std.dev, limits, data.name, labels, newdata, newdata.name,
newlabels, nsigmas=3, confidence.level)
```

Arguments

`data`	Data file.
`measurements`	Variable with the measurements.
`samples`	Variable with the samples.
`sizes`	A value or a vector of values specifying the sample sizes associated with each group. For continuous data provided as data frame or matrix the sample sizes are obtained counting the non-`NA` elements of each row. For `"p"`, `"np"` and `"u"` charts the argument `sizes` is required.
`type`	A character string specifying the group statistics to compute: "xbar", "R", "S", "xbar.one", "p", "np", "c", "u" or "g". See details section for further information and the help manual of the function link[qcc]qcc of the package qcc (Scrucca, 2017).
`subset`	With this argument it is possible to select a subset of the data. If it is a vector with two values, it means a range. For example, c(1,30) means the groups 1 to 30. A vector with more than two values means that the groups indicated in the vector are selected. The number of data in each group and the number of the group is defined in the variable of the argument *samples*.
`center`	A value specifying the center of group statistics or the "target" value of the process.
`std.dev`	A value or an available method specifying the within-group standard deviation(s) of the process.
`limits`	A two-values vector specifying control limits.
`data.name`	A string specifying the name of the variable which appears on the plots. If not provided is taken from the object given in the argument *measurements*.
`labels`	A character vector of labels for each group.
`newdata`	With this argument it is possible to select a new subset of the data, which are used for plotting but not included in the computations. If it is a vector with two or more values, as explained in the argument *subset*.
`newdata.name`	A string specifying the name of the variable which appears on the plots. If not provided is taken from the object given in the argument *as newdata*.
`newlabels`	A character vector of labels for each new group defined in the argument *newdata*.

`nsigmas` A numeric value specifying the number of sigmas to use for computing control limits. It is ignored when the *confidence.level* argument is provided.

`confidence.level`
A numeric value between 0 and 1 specifying the confidence level of the computed probability limits.

Details

Another phase of quality control consists in planning, documenting and conveniently implementing the necessary controls to ensure quality maintenance, using the results obtained in the previous phases.

The improvement achieved in the results must be quantified, the mechanisms and protocols for measurement and monitoring of the processes established, the alarm signals or deviation notices that indicate that some action is necessary, and the actions to be carried out in those cases. All this must be properly documented.

In this control phase the Shewhart charts are used. These charts allow you to observe the follow-up of a process, and know if it develops properly or deviates from the expected and, in that case, they help to find the problem and apply the correct solution.

The process must maintain the average value of the objective variable within these limits, for which it is useful to represent the mean in its temporal evolution. You must also keep the variability within reasonable limits, for which the standard deviation or range is usually represented. Although the standard deviation is usually considered the best indicator of variability, in the area of quality control the range or route is frequently used, difference between maximum and minimum value in a sample, for its ease of calculation.

In the argument *type* is poosible to specify the group statistics to compute:

	Statistic charted	Chart description
`"xbar"`	mean	means of a continuous process variable
`"R"`	range	ranges of a continuous process variable
`"S"`	standard deviation	standard deviations of a continuous variable
`"xbar.one"`	mean	one-at-time data of a continuous process variable
`"p"`	proportion	proportion of nonconforming units
`"np"`	count	number of nonconforming units
`"c"`	count	nonconformities per unit
`"u"`	count	average nonconformities per unit
`"g"`	count	number of non-events between events

FUNCTIONS

The plot is performed with the function qcc of the package qcc (Scrucca, 2017). For further details see Guisande & Vammonde (2012).

EXAMPLE

In the example there are data on the length of a metal part, whose nominal value must be 80 mm, which consist of 300 values corresponding to 60 samples of 5 units. The variable "Measurement" indicates the value, and "Sample" the set to which it belongs. The variability of the manufacturing process means that each piece has a measurement close to the nominal value, within reasonable margins, but mismatches may occur that cause a percentage of defective parts inadmissible.

Example 1 with the mean.

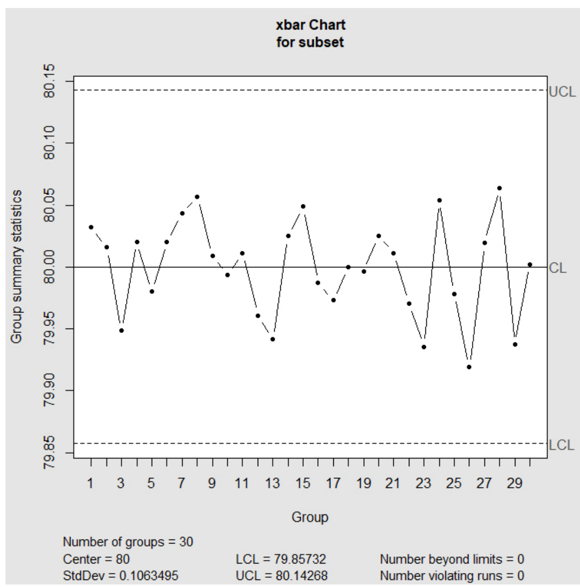
In the first example the chart of means is shown, only including the first 30 groups, the argument emphsubset=c(1,30). As each group consists of 5 samples, there are a total of 150 data.

The chart shows that the process seems to be under control. The average values of the samples of 5 units randomly oscillate around the nominal value.

The control limits in the graph, *LCL* and *UCL*, correspond to 3 times the standard deviation of the mean (only 2.67 per thousand of the values are expected to be outside them), and are calculated with the data itself.

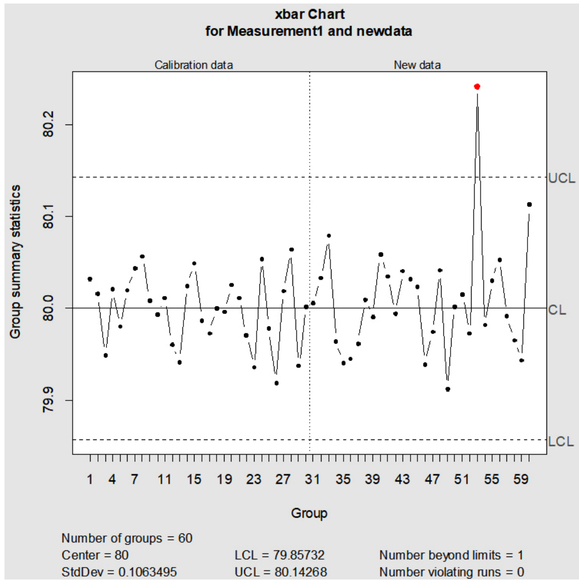
The legend of the graph also indicates that there are no values outside limits (Number beyond limits), either groups outside the limits (Number violating runs).

A run is a set of 5 (because there were 5 samples in each run, as it is specified in the variable samples) or more consecutive values above or below the average, and could indicate a mismatch in the process.



Example 2 with the mean and new data for testing.

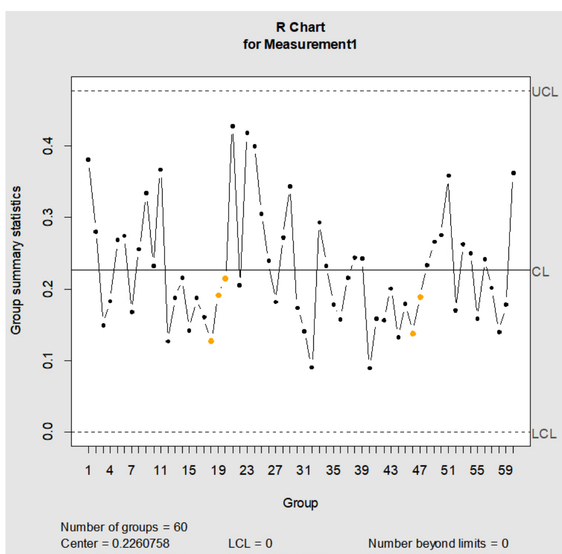
In the second example, we keep the sample already used (30 groups of 5) to perform the calculations and now add the remaining groups, from 31 to 60. The new data is added with the argument *newdata=c(31,60)*. These new data are not included to make the statistic and they are just plotted. Reserve some data to see if anomalies are observed, allows to control the quality of the process.



In the new chart it is observed that, while maintaining the control limits of the previous chart, there is a value outside the limits, an occasional mismatch, which in principle does not matter, since the subsequent process seems to remain under control.

Example 3 with the range.

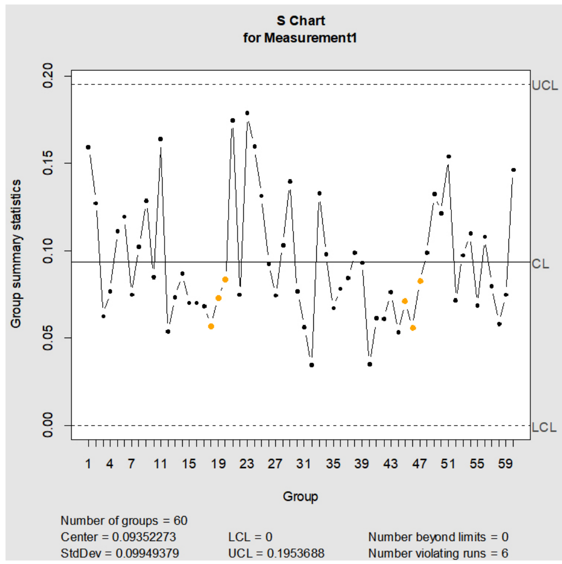
In this example, we work with all the data and it is used the range as the statistic. To do this, the argument *type="R"*. An excessively high range indicates a large variability that can lead to a large number of defective elements in the product.



It is observed that the variability is kept under control. The presence violating runs is usually not worrying, when it comes to values below the mid-range (runs below the horizontal continuous line).

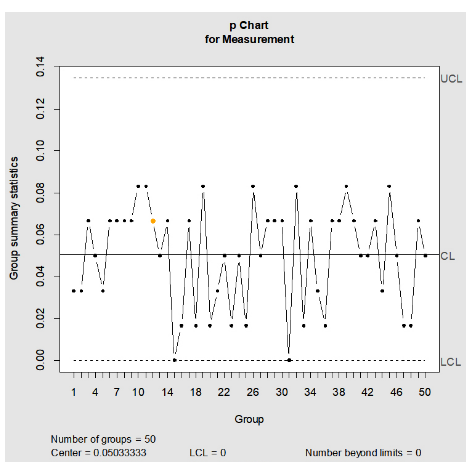
Example 4 with the standard deviation.

In this example, the standard deviation is used, a more appropriate measure in general to measure the variability, since it is not so influenced by outliers. To get this new chart, simply change the argument *type="S"*. The chart is very similar to that obtained with the range.



Example 5 with qualitative data.

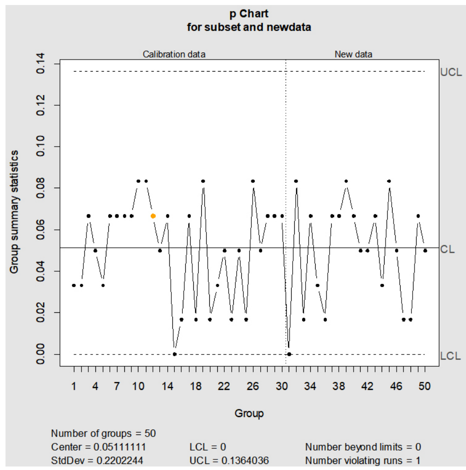
Sometimes the objective variable is not quantitative but qualitative, such as a defective or non-defective element. We will use an example in which the product consists of fruit units (kiwis) packaged in boxes of 60 units. The inspection determines the number of units that have a defect of any kind. It is interesting to keep the percentage of defective units below an allowable limit. A box is sampled every hour chosen at random. The data format consists of the variable "Size", which indicates the size of the samples (60 units, a complete box, in all cases), and another variable called "Defects" that shows the number of defective units. The number of boxes reviewed is 50.



The chart shows the sequence of proportions of defective elements for the data set. Control limits are automatically set based on the data, based on your own variability. In this example, no element outside the limits is observed, and the presence of sporadic streaks is not worrying.

Example 6 with qualitative data, a subset of data and newdata for testing.

In this example, a chart is constructed with the first 30 elements of the sample, using the argument *subse =c(1,30)*, and checks if the process is also controlled with another sample additionally, in this case formed by the last 20 boxes, using the argument *newdata=c(31,50)*.



Value

Different types of Shewhart charts are obtained.

References

Guisande, C. & Vaamonde, A. (2012) *Gráficos estadísticos y mapas con R*. Ediciones Díaz de Santos, Madrid, 367 pp.

Scrucca, L. (2017) Quality Control Charts. R package version 2.7. Available at: https://CRAN.R-project.org/package=qcc.

Examples

```
## Not run:
##Example 1 with the mean and a subset of data

data(Z34)

F98(data=Z34, measurements="Measurement", samples="Sample", subset=c(1,30), center=80)

##Example 2 with the mean, a subset of data and newdata for testing

data(Z34)

F98(data=Z34, measurements="Measurement", samples="Sample", subset=c(1,30),
center=80, newdata=c(31,60))
```

```
###Example 3 with the range as statistic and all data

data(Z34)

F98(data=Z34, measurements="Measurement", samples="Sample", type="R")

###Example 4 with standard deviation as statistic and all data

data(Z34)

F98(data=Z34, measurements="Measurement", samples="Sample",  type="S")

###Example 5 with qualitative data

data(Z35)

F98(data=Z35, measurements="Defects", sizes="Size", type="p")

###Example 6 with qualitative data, a subset of data and newdata for testing

data(Z35)

F98(data=Z35, measurements="Defects", sizes="Size", type="p", subset=c(1,30),
newdata=c(31,50))


## End(Not run)
```

F99 *BOXPLOT WITH THREE CATEGORICAL VARIABLES*

Description

A boxplot with three categorical variables.

Usage

```
F99(data, varY, varX, group1, group2, jitter=FALSE, mar=c(0.5,5,0.5,1),
ResetPAR=TRUE, PAR=NULL, OrderCatX=NULL, LabelCatX=NULL, OrderCat1=NULL,
LabelCat1=NULL, OrderCat2=NULL, LabelCat2=NULL, COLOR=NULL, BOXWEX=0.4,
XCEX=1, XLAS=1, XFONT=2, XTICK=TRUE, XCOLOR="grey", COLREC = "#87CEEB32",
YLAB=NULL, CEXYLAB=1.7, YLIM=NULL, MFROW=NULL, CEXJITTER=2.5, XLTY=1,
BOXPLOT=NULL, LEGEND=NULL, MTEXT= NULL, TEXT=NULL)
```

Arguments

data	Data file.
varY	Dependent variable.

`varX`	Variable with the categories that are depicted in the *X axis*.
`group1`	Second variable.
`group2`	Third variable with categories.
`jitter`	If it is TRUE points are added with the function jitter of the base package.
`mar`	Margins of the boxplot.
`ResetPAR`	If it is FALSE, the default condition of the function PAR is not placed and maintained those defined by the user in previous graphics.
`PAR`	It accesses the function PAR that allows to modify many different aspects of the graph.
`OrderCatX`	It allows to specify a vector with the order in which the categories of the variable *varX* are shown.
`LabelCatX`	It allows to specify a vector with the names of the categories of the variable *varX*.
`OrderCat1`	It allows to specify a vector with the order in which the categories of the variable *group1* are shown.
`LabelCat1`	It allows to specify a vector with the names of the categories of the variable *group1*.
`OrderCat2`	It allows to specify a vector with the order in which the categories of the variable *group2* are shown.
`LabelCat2`	It allows to specify a vector with the names of the categories of the variable *group2*.
`COLOR`	Vector with the color of the categories or just one color for all categories of the variable *group*.
`BOXWEX`	A scale factor to be applied to all boxes. It is useful when there are many groups, because this argument allows to make the boxes narrower.
`XCEX`	Size of the text in the *X* axis.
`XLAS`	Axis label orientation: 0 is parallel to the shaft, 1 is horizontal, 2 is perpendicular, and 3 is vertical.
`XFONT`	Font type of the text in the *X* axis. The value 1 is a normal type, 2 is written in bold, 3 is written in italics and 4 is written in italics and bold.
`XTICK`	If it is TRUE, ticks are added in the *X* axis.
`XCOLOR`	Color of the lines that divide the groups.
`COLREC`	Color of the shaded area for the variable *group2*.
`YLAB`	Legend of *Y* axis.
`CEXYLAB`	Size of the *Y* legend.
`YLIM`	Limits of *Y* axis.
`MFROW`	It allows to specify the boxplot panel. It is a vector with two numbers, for example c(2,5) which means that the boxplots are put in 2 rows and 5 columns.
`CEXJITTER`	Size of the points depicted with the argument *jitter*.

`XLTY`	It defines the type of lines that divide the groups: 0 No line, 1 Solid line, 2 Dashed line, 3 Dotted line, 4 Line of dots and dashes, 5 Dash line and 6 Double stripe.
`BOXPLOT`	It allows to specify the characteristics of the function boxplot.
`LEGEND`	It allows to include a legend to the graph.
`MTEXT`	It allows to add text on the margins of the graph.
`TEXT`	It allows to add text in any area of the inner part of the graph.

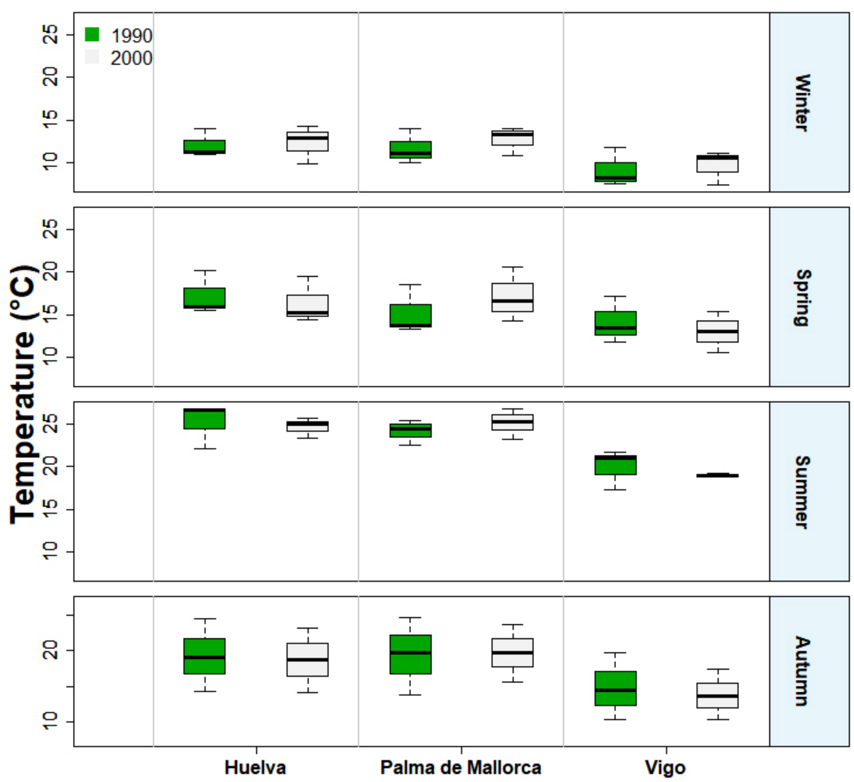
Details

FUNCTIONS

The plot is performed with the functions boxplot of the graphics package and jitter of the base package.

EXAMPLE

The data are monthly mean temperature for 1990 and 2000 in three cities in Spain: Huelva, Palma de Mallorca and Vigo. They were obtained from the Agencia Estatal de Meteorología of Spain `https://www.aemet.es/es/portada`.



Value

A boxplot with three categorical variables.

Examples

```
## Not run:

data(Z13)

F99(data=Z13, varY="Temperature", varX="City", group1="Year", group2="Season",
XCEX=1.5, YLAB="Temperature (C)")

## End(Not run)
```

Z1 *MORPHOMETRIC VARIABLES OF CHARACIFORMS*

Description

Morphometric data of several species of Characiforms, as the length of the dorsal fin base (M12), body height (M11), etc. For details see Guisande et al. (2010).

Usage

```
data(Z1)
```

Format

An data frame with 31 columns: taxonomic data (order, family, genus and species) and 27 morphometric variables.

Source

http://www.ipez.es/ipez/index_country/index.html

References

Guisande, C., Manjarrés-Hernández, A., Pelayo-Villamil, P., Granado-Lorencio, C., Riveiro, I., Acuña, A., Prieto-Piraquive, E., Janeiro, E., Matías, J.M., Patti, C., Patti, B., Mazzola, S., Jiménez, S., Duque, V. & Salmerón, F. (2010) IPez: An expert system for the taxonomic identification of fishes based on machine learning techniques. *Fisheries Research*, 102, 240-247.

Z10 *ALTIMETRY IN THE HIMALAYAN REGION*

Description

Latitude, logitude and altitude (in km) in the Himalayan region, from 21.91 to 60.91 N and 68 to 108 W.

Usage

```
data(Z10)
```

Format

Two colums with the latitude and longitude and the rest of colums is a matrix with the altitude.

Z11 *BATHYMETRY*

Description

Latitude, logitude and depth (in meters) from 33 to 35 N and 130 to 150 W.

Usage

```
data(Z10)
```

Format

Three colums with the latitude, longitude and depth.

Z12 *GEOGRAPHICAL RECORDS AND ALTITUDE OF FRESHWATER FISH SPECIES*

Description

Geographical records and altitude of fish freshwater species of the genus Cyphocharax (Guisande et al., 2010).

Usage

```
data(Z12)
```

Format

An data frame with 3 columns: Longitude, Latitude and Altitude.

Source

http://www.ipez.es/ipez/index_country/index.html

References

Guisande, C., Manjarrés-Hernández, A., Pelayo-Villamil, P., Granado-Lorencio, C., Riveiro, I., Acuña, A., Prieto-Piraquive, E., Janeiro, E., Matías, J.M., Patti, C., Patti, B., Mazzola, S., Jiménez, L.F., Duque, S. & Salmerón, F. (2010) IPez: An expert system for the taxonomic identification of fishes based on machine learning techniques. *Fisheries Research*, 102, 240-247.

`Z13` *TEMPERATURE AND PRECIPITATION IN CITIES OF SPAIN*

Description

Monthly means temperature and precipitation in 1990 and 2000 in three cities in Spain: Huelva, Palma de Mallorca and Vigo.

Usage

```
data(Z13)
```

Format

An data frame with 8 columns: city, year, mean temperature, mean precipitation, month, season, color of the labels and season only for the city of Huelva.

Source

https://www.aemet.es/es/portada.

`Z14` *HEIGHT AND WEIGHT OF CHILDREN*

Description

Height and weight data for children aged 2-5 years.

Usage

```
data(Z14)
```

Format

An array (matrix) with 3 columns: age, weight and height.

Z15 ABILITY TO REMEMBER

Description

In an experiment conducted with expert tasters and people who had no experience tasting, they were taught to identify 15 types of wines from different regions. Variations in ability to ascertain the wine provenance over time (after one hour, one day, one week and one month) was measured between experts and non-experts. For every time, each person assessed a large number of samples and the degree of success was recorded on a scale of 0 to 12.

Usage

```
data(Z15)
```

Format

An data frame with 3 columns: if taster has or does not have any experience (YES / NO), the measurement time (Hour, Day, Week and Month) and a degree of success on a scale of 0 to 12.

Z16 PRESENCE OF THE WOLF AND ENVIRONMENTAL VARIABLES

Description

Presence of the wolf (*Canis lupus*) and mean of environmental variables in cells of 1 degree x 1 degree around the world.

Usage

```
data(Z16)
```

Format

A data frame of the presence of the wolf and the means altitude, annual temperature (BIO1), diurnal range (BIO2), isothermality (BIO3), temperature seasonality (BIO4), maximum temperature of the warmest month (BIO5), annual precipitation (BIO12), primary terrestrial production (PP), slope and vegetation index (VI) in cells of 1 degree x 1 degree around the world.

Source

The range map of the wolf was obtained from the International Union for Conservation of Nature (IUCN) at the web page https://www.iucn.org/. The data of the means annual temperature (BIO1), diurnal range (BIO2), isothermality (BIO3), temperature seasonality (BIO4), maximum temperature of the warmest month (BIO5) and annual precipitation (BIO12) were downloaded from the web https://www.worldclim.org/. Both range map and environmental variables were inputted into ModestR (www.ipez.es/ModestR) and the output file from ModestR is a CSV file that was converted to a RData file.

References

García-Roselló, E., Guisande, C., González-Dacosta, J., Heine, J., Pelayo-Villamil, P., Manjarrés-Hernández, A., Vaamonde, A. & Granado-Lorencio, C. (2013) ModestR: a software tool for managing and analyzing species distribution map databases. *Ecography*, 36, 1202-1207.

Hijmans, R.J., Cameron, S.E., Parra, J.L., Jones, P.G. and Jarvis, A. (2005) Very high resolution interpolated climate surfaces for global land areas. *International Journal of Climatology*, 25, 1965-1978.

IUCN (2012) The IUCN Red List of Threatened Species. Version 2012.2. https://www.iucnredlist.org/. Downloaded on 17 October 2012.

Pelayo-Villamil, P., Guisande, C., González-Vilas. L., Carvajal-Quintero. J.D., Jiménez-Segura, L.F., García-Roselló, E., Heine, J., González-Dacosta, J., Manjarrés-Hernández, A., Vaamonde, A., Granado-Lorencio, C. (2012) ModestR: Una herramienta infromática para el estudio de los ecosistemas acuáticos de Colombia. *Actualidades Biológicas*, 34, 225-239.

Z17 *AMINO ACIDS IN ROTIFERS*

Description

Percentages of three amino acids in different species of rotifers obtained from ponds of Doñana National Park (Spain) (Guisande et al., 2008).

Usage

```
data(Z17)
```

Format

A data frame with five columns: pond, species and the percentages of aspartate, serine and glutamate.

References

Guisande, C., Granado-Lorencio, C, Toja, J. & León, D. (2008 Identification of the main factors in structuring rotifer community assemblages in ponds of Doñana National Park using the amino acid composition of the species. *Limnetica*, 27: 273-284.

Z18 *DEMOGRAPHIC PARAMETERS FOR COUNTRIES*

Description

Demographic parameters from 57 countries in Europe, Africa and America.

Usage

```
data(Z18)
```

Format

An data frame with 7 columns: continent, country, scores of the Principal Component Analysis (PCA) 1 and 2, variables of the PCA, and position of the variables in the axes 1 and 2 of the PCA.

Z19 *RECORDS OF A FRESHWATER FISH SPECIES*

Description

Records of the freshwater fish species *Perca fluviatilis* in diferent geographic coordinates, and the temperature and altitude.

Usage

```
data(Z19)
```

Format

An data frame with 5 columns: Longitude, latitude, records, altitude and temperature.

Z2 *TEMPERATURE PREDICTED BY DIFFERENT MODELS*

Description

Monthly temperature observed and predicted by different models.

Usage

```
data(Z2)
```

Format

An data frame with 6 columns: month, temperature observed and temperature predicted by four models.

Z20 *STUDY ON SMOKING*

Description

Range data in men and women who smoke in different work centres. The categories used were: 1 (Non-smoker), 2 (between 1 and 10 cigarettes a day), 3 (between 11 and 20 cigarettes a day), 4 (from 1 to 2 packs per day) and 5 (more than 2 packs a day). There is also information if any parents of these workers are smokers and their categories are: workers in which one parent is a smoker (category value = 1) and the other group for those in which none of his/her parents is a smoker (category value = 0).

Usage

```
data(Z20)
```

Format

An data frame with 5 columns: age, gender, workplace, if either parent smokes and degree of smoking.

Z21 *METALS IN SEDIMENT*

Description

Concentration of metals at different depth in the sediment of the Yahuarkaka lake in Leticia (Amazonas, Colombia).

Usage

```
data(Z21)
```

Format

An data frame with 6 columns: depth and the concetration of Cr (chromium), Co (cobalt), Ni (nickel), Pb (lead) and Al (aluminum).

Z22 *AIR POLLUTANTS*

Description

Hourly data of air pollutants, wind speed and wind direcction in Santiago de Compostela (Spain) from 1/11/2015 to 31/12/2015.

Usage

```
data(Z22)
```

Format

An data frame with 10 columns: date, sulfur dioxide (SO2), nitrogen monoxide (NO), nitrogen dioxide (NO2), nitrogen oxides (NOX), carbon monoxide (CO), ozone (O3), particulate matter 10 micrometers or less in diameter (PM10), wind speed (Wd) and wind direction (Ws).

Source

https://www.meteogalicia.gal/web/index.action.

Z23 *MAXIMUM AND MINIMUM TEMPERATURES AND PRECIPITATION IN CITIES OF SPAIN*

Description

Daily maximum and minimum temperatures and precipitation in 1990 and 2000 in three cities in Spain: Huelva, Palma de Mallorca and Vigo.

Usage

```
data(Z23)
```

Format

An data frame with 5 columns: City, T.max, T.min and precipitation.

Source

https://www.aemet.es/es/portada.

Z24 — *MONTHLY MEAN TEMPERATURES AND PRECIPITATION IN HUELVA (SPAIN)*

Description

Monthly mean temperatures and precipitation in 1990 and 2000 in Huelva (Spain).

Usage

```
data(Z24)
```

Format

An 4X12 matrix, one column for each month, without NAs. First row is monthly precipitation (mm), second row is monthly average maximum daily temperature (degrees C), third row is monthly average minimum daily temperature (degrees C) and forth row is monthly absolute minimum daily temperature (degrees C).

Source

https://www.aemet.es/es/portada.

Z25 — *SPECIES RICHNESS OF FRESHWATER FISHES*

Description

Species richness of freshwater fish species in cells of 1 degree around the world (Guisande et al., 2010).

Usage

```
data(Z25)
```

Source

http://www.ipez.es/ipez/index_country/index.html

References

Guisande, C., Manjarrés-Hernández, A., Pelayo-Villamil, P., Granado-Lorencio, C., Riveiro, I., Acuña, A., Prieto-Piraquive, E., Janeiro, E., Matías, J.M., Patti, C., Patti, B., Mazzola, S., Jiménez, L.F., Duque, S. & Salmerón, F. (2010) IPez: An expert system for the taxonomic identification of fishes based on machine learning techniques. *Fisheries Research*, 102, 240-247.

Z26 *NATIONAL PARKS OF COLOMBIA*

Description

Shapes with the National Parks of Colombia.

Usage

```
data(Z26)
```

Z27 *AFRICA*

Description

Shapes with the countries of Africa and information about the population size in the year 2005.

Usage

```
data(Z27)
```

Z28 *Estimators obtained with the function KnowShape*

Description

Estimators obtained with the function KnowBPolygon using species of freshwater fish species in all the countries of the world (Guisande et al., 2010).

Usage

```
data(Z28)
```

Source

http://www.ipez.es/ipez/index_country/index.html

References

Guisande, C., Manjarrés-Hernández, A., Pelayo-Villamil, P., Granado-Lorencio, C., Riveiro, I., Acuña, A., Prieto-Piraquive, E., Janeiro, E., Matías, J.M., Patti, C., Patti, B., Mazzola, S., Jiménez, L.F., Duque, S. & Salmerón, F. (2010) IPez: An expert system for the taxonomic identification of fishes based on machine learning techniques. *Fisheries Research*, 102, 240-247.

Z29 *Earthquakes*

Description

Magnitude, longitude, latitude and depth of earthquakes around the world.

Usage

```
data(Z29)
```

Source

https://www.usgs.gov/programs/earthquake-hazards/earthquakes.

Z3 *ANNUAL DEMOGRAPHIC PARAMETERS FROM CONTINENTS*

Description

Annual demographic parameters from several continents.

Usage

```
data(Z3)
```

Format

An data frame with 10 columns: region, year, percentage of people with an age range from 0 to 14, percentage of people with an age range from 15 to 64, percentage of people older than 65, unemployment older than 65, unemployment younger than 15, growth rate, population size, percentage of women.

Source

https://www.worldbank.org/en/home.

Z30 *Academic performance*

Description

Causes of the poor performance of university students.

Usage

```
data(Z30)
```

`Z31` *Types of defects*

Description

Types of defects detected in the elaboration of a product and the observed number of each of these defects.

Usage

```
data(Z31)
```

`Z32` *Mechanical parts*

Description

Measurements of two mechanical parts of a car in mm.

Usage

```
data(Z32)
```

`Z33` *Mechanical pieces*

Description

Measurements taken by three workers to 10 different pieces and each worker measured two times each piece.

Usage

```
data(Z33)
```

`Z34` *Metal piece*

Description

Data of the length of a metal part, whose nominal value must be 80 mm, consisting of 300 values corresponding to 60 samples of 5 units.

Usage

```
data(Z34)
```

Z35 *Quality control of kiwis*

Description

Number of defective kiwis in groups of 60 units.

Usage

```
data(Z35)
```

Z4 *EARTHQUAKES*

Description

Magnitude and depth of several earthquakes which have happened around the world.

Usage

```
data(Z4)
```

Format

An data frame with 3 columns: Latitude/Longitude, depth and magnitude of the earthquake.

Source

https://www.usgs.gov/programs/earthquake-hazards/earthquakes.

Z5 *POPULATION PARAMETERS OF DIFFERENT COUNTRIES*

Description

Population size and annual growth in different countries.

Usage

```
data(Z5)
```

Format

An data frame with 4 columns: country, population size, growth rate and annual population growth from the web site world gazetter.

Z6 *SCORES OF A PRINCIPAL COMPONENT ANALYSIS*

Description

Scores of a Principal Component Analysis (PCA) performed to physicochemical parameters from lakes in Colombia.

Usage

```
data(Z6)
```

Format

An data frame with 4 columns: Region, lake and the scores of the dimensions 1 and 2.

Z7 *HUMAN POPULATION DENSITY BY SEX AND AGE GROUP IN SPAIN*

Description

Human population density by sex and age group in Spain for the years 1900 and 1991. Data were obtained from the Spanish Statistical Office.

Usage

```
data(Z7)
```

Format

An data frame with 7 columns: Age group, males in 1900, females in 1900, males in 1991, females in 1991, foreign males in 1991 and foreign females in 1991.

Source

http://www.ine.es.

Z8 *MORPHOMETRIC VARIABLES OF FRESHWATER FISHES*

Description

Morphometric data of several species of three families of freshwater fishes, as the length of the dorsal fin base (M12), body height (M11), etc. For details see Guisande et al. (2010).

Usage

```
data(Z8)
```

Format

An data frame with 31 columns: taxonomic data (order, family, genus and species) and 26 morphometric variables.

Source

http://www.ipez.es/ipez/index_country/index.html

References

Guisande, C., Manjarrés-Hernández, A., Pelayo-Villamil, P., Granado-Lorencio, C., Riveiro, I., Acuña, A., Prieto-Piraquive, E., Janeiro, E., Matías, J.M., Patti, C., Patti, B., Mazzola, S., Jiménez, S., Duque, V. & Salmerón, F. (2010) IPez: An expert system for the taxonomic identification of fishes based on machine learning techniques. *Fisheries Research*, 102, 240-247.

Z9 *X AND Y COORDINATES*

Description

X and Y coordinates, which may be used to estimate the functions of response surface plots.

Usage

```
data(Z9)
```

Format

An array (matrix) with 2 columns: x and y.

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