Package ‘BivRegBLS’

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Type Package
Title Tolerance Intervals and Errors-in-Variables Regressions in Method Comparison Studies
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Maintainer Bernard G Francq <BivRegBLS@gmail.com>
Description Assess the agreement in method comparison studies by tolerance intervals and errors-in-variables regressions. The Ordinary Least Square regressions (OLSv and OLSh), the Deming Regression (DR), and the (Correlated)-Bivariate Least Square regressions (BLS and CBLS) can be used with unreplicated or replicated data. The BLS and CBLS are the two main functions to estimate a regression line, while XY.plot and MD.plot are the two main graphical functions to display, respectively an (X,Y) plot or (M,D) plot with the BLS or CBLS results. Assuming no proportional bias, the (M,D) plot (Band-Altman plot) may be simplified by calculating horizontal lines intervals with tolerance intervals (beta-expectation (type I) or beta-gamma content (type II)).
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Author Bernard G Francq [cre, aut], Marion Berger [aut]
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Assess the agreement in method comparison studies by tolerance intervals and (correlated)-errors-in-variables regressions. The results can then be displayed in an (X,Y) plot or (M,D) plot (Bland-Altman plot). The vertical and horizontal Ordinary Least Square regressions (OLSv, OLSh), the Deming Regression (DR), and the (Correlated)-Bivariate Least Square regressions (BLS and CBLS) can be used with unreplicated or replicated data. The measurement error variances and their ratio (lambda) can be estimated by an unbiased estimator with replicated data. If lambda is unknown and not estimatable, there is no unique solution and all the potential solutions can be calculated from OLSv to OLSh in a (X,Y) plot (extreme solutions), or equivalently from a correlation (between the measurement errors in a Bland-Altman plot) -1 to +1 with the CBLS in a (M,D) plot. The BLS and CBLS are the two main regressions. They provide a table of the estimates (estimates, standard error, confidence intervals and pvalues for separate and joint hypotheses), the coordinates of the joint confidence interval (confidence region, or ellipse), and the four following hyperbolic intervals: the Confidence Intervals (CI), the Confidence Bands (CB), the Predictive Intervals (PI), and the Generalized predictive Intervals (GI). The XY.plot and MD.plot are the two main graphical functions to display an (X,Y) plot or (M,D) plot with the desired results. If one can assume no proportional bias, the (M,D) plot may be simplified by calculating horizontal lines intervals with the beta-expectation tolerance interval (type I) or the beta-gamma content tolerance interval (type II).
Details

Package: BivRegBLS
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License: AGPL-3

The most important functions are BLS (Bivariate Least Square regression) and CBLS (Correlated Bivariate Least Square regression). The results can then be plotted with respectively the functions \texttt{XY.plot} and \texttt{MD.plot}. Univariate tolerance intervals (bounded by two straight lines in the (M,D) plot) for the differences by two measurement methods can be obtained by the function \texttt{MD.horiz.lines}.

Note

BivRegBLS was developed with a partnership between the University of Glasgow and Sanofi. We gratefully thank Christophe Agut, Delphine Attonaty, Armand Berges, Guy Mathieu, Sylvain Nicolas, Veronique Onado and Frank Pellissier for their helpful suggestions and comments.

Author(s)

Bernard G FRANCQ <BivRegBLS@gmail.com>, Marion BERGER <marion.berger@sanofi.com>
Maintainer: Bernard G Francq <BivRegBLS@gmail.com>

References


Examples

```r
library(BivRegBLS)
data(SBP)
### Descriptive statistics
res=desc.stat(data=SBP,xcol=c("J1","J2","J3"),ycol=8:10)
raw.plot(data.plot=res,xname="J",yname="S",graph="XY.bar.SEM")
### BLS regression in an (X,Y) plot
```
Description

If the data are log-normal, the user can apply a logarithmic transformation. Then, `antilog.pred` will automatically back-transform (exponentiate) the data and the predictions (hyperbolic intervals) obtained by the `BLS`, `CBLS`, `MD.horiz.lines`, `FullCIs.XY` or `FullCIs.MD` functions.

Usage

`antilog.pred(results = NULL, base = 10)`

Arguments

- `results`: an object of class `BLS`, `CBLS`, `MD.horiz.lines`, `CIs.XY` or `CIs.MD`.
- `base`: a character string or a numeric value. Options available are: 10 (default value) or "e".

Details

`antilog.pred` is automatically called by the argument `antilog` in the functions `XY.plot` or `MD.plot`.

Value

An object of class `BLS`, `CBLS`, `MD.horiz.lines`, `CIs.XY` or `CIs.MD`.

Author(s)

Bernard G FRANCQ

See Also

`BLS`, `CBLS`, `MD.horiz.lines`, `FullCIs.XY`, `FullCIs.MD`
Aromatics

Examples

library(BivRegBLS)
data(SBP)
SBPlog=SBP
SBPlog[,2:10]=log(SBPlog[,2:10])
res.BLS.log=BLS(data=SBPlog,xcol=c("J1","J2","J3"),ycol=8:10)
res.BLS=antilog.pred(results=res.BLS.log,base="e")

Aromatics Aromatics petroleum data

Description

Aromatics measurements in light and medium petroleum by HPLC and GC MS.

Usage

data(Aromatics)

Format

A data frame with 35 observations on the following 8 variables:

- Sample  a factor with the sample type
- Type    a factor with the following levels: HD (Heavy Diesel), LD (Light Diesel), LGO (Light Gas Oil), MGO (Medium Gas Oil)
- HPLCmono a numeric vector with the monoaromatics measurements by HPLC.
- GCMSmono a numeric vector with the monoaromatics measurements by GC MS.
- HPLCdi   a numeric vector with the diaromatics measurements by HPLC.
- GCMSdi   a numeric vector with the diaromatics measurements by GC MS.
- HPLCtri  a numeric vector with the triaromatics measurements by HPLC.
- GCMStri  a numeric vector with the triaromatics measurements by GC MS.

Source

C-A B Ferrer, B M Celis, A B Velandia, Development of a methodology to determine the aromatic structural distribution in light and medium petroleum fractions by HPLC. Cienc. Tecnol. Futuro, 2006; 3 (2), 149-162.

References

Examples

```r
data(Aromatics)
str(Aromatics)
head(Aromatics)
```

**Bivariate Least Square regression (BLS)**

**Description**

Estimate the (homoscedastic) Bivariate Least Square regression with unreplicated or replicated data (in a (X,Y) plot).

**Usage**

```r
BLS(data = NULL, xcol = 1, ycol = 2, var.x = NULL, var.y = NULL,
    df.var.x = Inf, df.var.y = Inf, ratio.var = NULL, conf.level = 0.95,
    pred.level = 0.95, npoints = 1000, qx = 1, qy = 1, xpred = NULL)
```

**Arguments**

- `data` a data set (data frame or matrix).
- `xcol` a numeric vector to specify the X column(s) or a character vector with the column names.
- `ycol` a numeric vector to specify the Y column(s) or a character vector with the column names.
- `var.x` a numeric variable for the variance of the measurement error of device X if known.
- `var.y` a numeric variable for the variance of the measurement error of device Y if known.
- `df.var.x` a numeric variable for the degrees of freedom of the variance of the measurement error of device X if known.
- `df.var.y` a numeric variable for the degrees of freedom of the variance of the measurement error of device Y if known.
- `ratio.var` a numeric value for \( \lambda \), the ratio of the measurement error variances (Y over X) if known.
- `conf.level` a numeric value for the confidence level (expressed between 0 and 1).
- `pred.level` a numeric value for the predictive level (expressed between 0 and 1).
- `npoints` a numeric variable for the number of points to smooth the hyperbolic curves.
- `qx` a numeric value to predict the mean of qy Y future values from the mean of qx X values (generalized interval).
- `qy` a numeric value to predict the mean of qy Y future values from the mean of qx X values (generalized interval).
- `xpred` a numeric vector for customized predictions at given X values.
Details

The data argument is mandatory. If the data are unreplicated, then the measurement error variances must be given or their ratio (\(\lambda\)). The confidence level is used for the confidence intervals of the parameters (\(\lambda_{XY}, \beta\) (slope), \(\alpha\) (intercept)), the hyperbolic confidence intervals (the prediction of the expectation of Y for a given X) and the hyperbolic confidence bands. The predictive level is used for the hyperbolic predictive intervals (the prediction of a future Y for a given X) and the hyperbolic generalized intervals (the prediction of the mean of q future Y values from a given (mean of) X). The results (\(X_{ij}, Y_{ik}, X_i, Y_i, n_{xi}, n_{yi}, \text{variances}_x, \text{variances}_y\)) are reordered according to the increasing values of \(X_i\) (the X mean values).

Value

A BLS class object, a list including the following elements:

- \(x_{ij}\)  a table with the (replicated) X measurements (replicates are in columns).
- \(y_{ik}\)  a table with the (replicated) Y measurements (replicates are in columns).
- \(X_i\)  a vector with the means of the X measurements.
- \(Y_i\)  a vector with the means of the Y measurements.
- \(n_{xi}\)  a vector with the number of X replicates per sample (patient).
- \(n_{yi}\)  a vector with the number of Y replicates per sample (patient).
- \(\text{variances}_x\)  a vector with the variances calculated on the X replicates per sample (patient).
- \(\text{variances}_y\)  a vector with the variances calculated on the Y replicates per sample (patient).
- \(\text{Lambda}.XY\)  a table with the value of \(\lambda_{XY}\) and its confidence interval.
- \(\text{Ellipse}.BLS\)  a two columns matrix with the coordinates of the joint confidence interval (confidence region, ellipse) for the parameters (\(\beta, \alpha\)).
- \(\text{Estimate}.BLS\)  a table (data frame) with the estimates of the intercept and the slope, standard error, confidence interval and pvalue (null hypothesis: slope = 1, intercept = 0).
- \(\text{Pred}.BLS\)  a data frame with npoints rows (from the minimum to the maximum of the observed X values) and the following columns: the X values where the predictions are calculated (X0), the Y predicted values (Ypred), the lower and upper bounds of the confidence intervals, predictive intervals, generalized intervals and confidence bands.
- \(\text{xpred}.BLS\)  a data frame with the customized predictions and the same columns than \(\text{Pred}.BLS\).

Author(s)

Bernard G FRANÇQ

References

Francq BG, Govaerts BB. Measurement methods comparison with errors-in-variables regressions.

See Also

CBLS

Examples

library(BivRegBLS)
data(SBP)
# BLS regression on replicated data
res.BLS1=BLs(data=SBP,xcol=c("J1","J2","J3"),ycol=8:10,qX=3,qY=3,xpred=c(100,120,140,160))
# BLS regression on unreplicated data with measurement error variances previously estimated
res.BLS2=BLs(data=SBP,xcol=c("J1"),ycol="S1",var.X=80,var.Y=50,df.var.X=100,df.var.Y=100)

---

**BLS.ht**  
*Bivariate Least Square regression (BLS)*

**Description**

Estimate the heteroscedastic Bivariate Least Square regression with replicated data or variance functions.

**Usage**

```
BLS.(ht)(data = NULL, xcol = NULL, ycol = NULL, var.x.col = NULL, var.y.col = NULL, 
        var.x.formula = NULL, var.y.formula = NULL, nxi.col = NULL, nyi.col = NULL, 
        df.var.x.col = NULL, df.var.y.col = NULL, conf.level = 0.95, pred.level = 0.95, 
        npoints = 1000, qx = 1, qy = 1, xpred = NULL, tol = 1e-05)
```

**Arguments**

- **data**: a data set (data frame or matrix).
- **xcol**: a numeric vector to specify the X column(s) or a character vector with the column names.
- **ycol**: a numeric vector to specify the Y column(s) or a character vector with the column names.
- **var.x.col**: a numeric or character variable to specify the column with the heteroscedastic variances of X.
- **var.y.col**: a numeric or character variable to specify the column with the heteroscedastic variances of Y.
- **var.x.formula**: a character string with a formula related to X that will be interpreted as a variance function, i.e. var.x.formula="exp(2*X+3)".
### var.y.formula
A character string with a formula related to Y that will be interpreted as a variance function, i.e. var.y.formula="exp(2*Y+3)".

### nxi.col
A numeric or character variable to specify the column with the number of replicates in X on which the variances were calculated.

### nyi.col
A numeric or character variable to specify the column with the number of replicates in Y on which the variances were calculated.

### df.var.x.col
A numeric or character variable to specify the column with the degrees of freedom of the heteroscedastic variances in X.

### df.var.y.col
A numeric or character variable to specify the column with the degrees of freedom of the heteroscedastic variances in Y.

### conf.level
A numeric value for the confidence level (expressed between 0 and 1).

### pred.level
A numeric value for the predictive level (expressed between 0 and 1).

### npoints
A numeric variable for the number of points to smooth the hyperbolic curves.

### qx
A numeric value to predict the mean of qy Y future values from the mean of qxX values (generalized interval).

### qy
A numeric value to predict the mean of qy Y future values from the mean of qx X values (generalized interval).

### xpred
A numeric vector for customized predictions at given X values.

### tol
A numeric variable to change the tolerance for the BLS to converge.

### Details
The data argument is mandatory. If the data are unreplicated, then the measurement error variances must be given. The confidence level is used for the confidence intervals of the parameters ($\beta$, $\alpha$), the hyperbolic confidence intervals (the prediction of the expectation of Y for a given X) and the hyperbolic confidence bands. The predictive level is used for the hyperbolic predictive intervals (the prediction of a future Y for a given X) and the hyperbolic generalized intervals (the prediction of the mean of qy future Y values from a given (mean of) X).

The results ($x_{ij}$, $y_{ik}$, $x_i$, $y_i$, $n_{xi}$, $n_{yi}$, variances_x, variances_y) are reordered according to the increasing values of $x_i$ (the X mean values).

### Value
A BLS.ht class object, a list including the following elements:

- **Xij**: A table with the (replicated) X measurements (replicates are in columns).
- **Yik**: A table with the (replicated) Y measurements (replicates are in columns).
- **Xi**: A vector with the means of the X measurements.
- **Yi**: A vector with the means of the Y measurements.
- **nxi**: A vector with the number of X replicates per sample (patient).
- **nyi**: A vector with the number of Y replicates per sample (patient).
- **variances_x**: A vector with the variances calculated on the X replicates per sample (patient).
- **variances_y**: A vector with the variances calculated on the Y replicates per sample (patient).
Estimated B.S. ht a two columns matrix with the coordinates of the joint confidence interval (confidence region, ellipse) for the parameters ($\beta$, $\alpha$).

Estimated B.S. ht a table (data frame) with the estimates of the intercept and the slope, standard error, confidence interval and pvalue (null hypothesis: slope = 1, intercept = 0).

Pred.BLS.ht a data frame with npoints rows (from the minimum to the maximum of the observed X values) and the following columns: the X values where the predictions are calculated (X0), the Y predicted values (Ypred), the lower and upper bounds of the confidence interval, predictive interval, generalized interval and confidence bands.

xpred.BLS.ht a data frame with the customized predictions and the same columns than Pred.BLS.ht.

Note

The prediction interval should be interpreted with caution as it is still under development.

Author(s)

Bernard G FRANCQ

References


See Also

BLS

Examples

library(BivRegBLS)
data(SBP)
res.BLS.ht=BLSh(data=SBP,xcol=cb("J1","J2","J3"),ycol=cb("S1","S2","S3"))

CBLS

Correlated Bivariate Least Square regression (CBLS)

Description

Estimate the Correlated Bivariate Least Square regression with replicated data (in a (M,D) plot) where M=(X+Y)/2 and D=Y-X.

Usage

CBLS(data = NULL, xcol = 1, ycol = 2, var.x = NULL, var.y = NULL, df.var.x = Inf, df.var.y = Inf, ratio.var = NULL, conf.level = 0.95, pred.level = 0.95, npoints = 1000, qx = 1, qy = 1, xpred = NULL)
Arguments

- **data**: a data set (data frame or matrix).
- **xcol**: a numeric vector to specify the X column(s) or a character vector with the column names.
- **ycol**: a numeric vector to specify the Y column(s) or a character vector with the column names.
- **var.x**: a numeric variable for the variance of the measurement error of device X if known.
- **var.y**: a numeric variable for the variance of the measurement error of device Y if known.
- **df.var.x**: a numeric variable for the degrees of freedom of the variance of the measurement error of device X if known.
- **df.var.y**: a numeric variable for the degrees of freedom of the variance of the measurement error of device Y if known.
- **ratio.var**: a numeric value for $\lambda$, the ratio of the measurement error variances (Y over X) if known.
- **conf.level**: a numeric value for the confidence level (expressed between 0 and 1).
- **pred.level**: a numeric value for the predictive level (expressed between 0 and 1).
- **npoints**: a numeric variable for the number of points to smooth the hyperbolic curves.
- **qx**: a numeric value to predict the mean of qy Y future values from the mean of qx X values (generalized interval).
- **qy**: a numeric value to predict the mean of qy Y future values from the mean of qx X values (generalized interval).
- **xpred**: a numeric vector for customized predictions at given M values.

Details

The data argument is mandatory. If the data are unreplicated, then the measurement error variances must be given or their ratio ($\lambda$) in order to calculate the correlation, $\rho_{MD}$, between the measurement errors of the differences (on the Y-axis) and the measurement errors of the means (on the X-axis). The confidence level is used for the confidence intervals of the parameters ($\rho_{MD}$, $\beta$ (slope), $\alpha$ (intercept)), the hyperbolic confidence intervals (the prediction of the expectation of Y for a given X) and the hyperbolic confidence bands. The predictive level is used for the hyperbolic predictive intervals (the prediction of a future Y for a given X) and the hyperbolic generalized intervals (the prediction of the mean of q future Y values for a given X).

Value

A CBLS class object, a list including the following elements:

- **Xij**: a table with the (replicated) X measurements (replicates are in columns).
- **Yik**: a table with the (replicated) Y measurements (replicates are in columns).
- **Xi**: a vector with the means of the X measurements.
- **Yi**: a vector with the means of the Y measurements.
Mi a vector with the means ((X+Y)/2) measurements.
Di a vector with the differences (Y-X) measurements.
nxi a vector with the number of X replicates per sample (patient).
nyi a vector with the number of Y replicates per sample (patient).
variances_x a vector with the variances calculated on the Y replicates per sample (patient).
variances_y a vector with the variances calculated on the Y replicates per sample (patient).
Rho.MD a table with the value of $\rho_{MD}$ (the correlation between the measurement errors of the means and the differences) and its confidence interval.
Ellipse.CBLS a two columns matrix with the coordinates of the joint confidence interval (confidence region, ellipse) for the parameters ($\beta$, $\alpha$).
Estimate.CBLS a table (data frame) with the estimates of the intercept and the slope, standard error, confidence interval and pvalue (null hypothesis: slope = 0, intercept = 0).
Pred.CBLS a data frame with npoints rows (from the minimum to the maximum of the observed X values) and the following columns: the X values where the predictions are calculated (X0), the Y predicted values (Ypred), the lower and upper bounds of the confidence interval, predictive interval, generalized interval and confidence bands.
xpred.CBLS a data frame with the customized predictions and the same columns than Pred.CBLS.

Author(s)
Bernard G FRANCQ

References

See Also
BLS

Examples
library(BivRegBLS)
data(SBP)
# CBLS regression on replicated data
res.CBLS1=CBLS(data=SBP,xcol=c("J1","J2","J3"),ycol=8:10,qx=3,qy=3,xpred=c(100,120,140,160))
# CBLS regression on unreplicated data with measurement error variances previously estimated
res.CBLS2=CBLS(data=SBP,xcol=c("J1"),ycol="S1",var.x=80,var.y=50,df.var.x=100,df.var.y=100)
**Description**

Calculate several descriptive statistics in method comparison studies per device (X and Y) and per type of samples.

**Usage**

```r
desc.stat(data = NULL, xcol = 1, ycol = 2, IDcol = NULL)
```

**Arguments**

- `data`: a data set (data frame or matrix).
- `xcol`: a numeric vector to specify the X column(s) or a character vector with the column names.
- `ycol`: a numeric vector to specify the Y column(s) or a character vector with the column names.
- `IDcol`: a numeric or character variable to specify the column with the different IDs or type of samples.

**Details**

If `IDcol` is null (as by default), the descriptive statistics are calculated for X and Y. Otherwise, the descriptive statistics are calculated for X and Y for each type of sample (each ID). This information is also used to differentiate the observations on a raw plot when the function `raw.plot` is used. The results (`Xij, Yik, Xi, Yi, nxi, nyi, variances_x, variances_y`) are reordered according to the increasing values of `Xi` (the X mean values).

**Value**

A list including the following elements:

- `Xij`: a table with the (replicated) X measurements (replicates are in columns).
- `Yik`: a table with the (replicated) Y measurements (replicates are in columns).
- `Xi`: a vector with the means of the X measurements.
- `Yi`: a vector with the means of the Y measurements.
- `IDs`: a vector with the different IDs.
- `nxi`: a vector with the number of X replicates per sample (patient).
- `nyi`: a vector with the number of Y replicates per sample (patient).
- `variances_x`: a vector with the variances calculated on the X replicates per sample (patient).
- `variances_y`: a vector with the variances calculated on the Y replicates per sample (patient).
- `Order.Xi`: a vector with the order of the means of the X replicates.
statistics

a table with different descriptive statistics per type of sample (rows): the number of sample (patient), the number of replicates in X and Y, the degrees of freedom of the measurement error variances in X and Y, the mean, the sum of squares (Sxx and Syy), the cross-product (Sxy), the variance, minimum, 1st quartile, median, 3rd quartile, maximum for X and Y, and the Pearson correlation coefficient and its square.

Author(s)

Bernard G FRANCQ

References


See Also

lambdas, raw.plot

Examples

library(BivRegBLS)
data(Aromatics)
res=desc.stat(data=Aromatics,xcol=3,ycol=4,IDcol=2)

df.WS          Degrees of freedom by Welch-Satterwaite

Description

Calculate the degrees of freedom from the Welch-Satterwaite equation for a linear combination of sample variances.

Usage

df.WS(variances = NULL, k = rep(1, length(variances)), dfs = NULL)

Arguments

variances         a numeric vector for the variances.
k              a numeric vector with the multiplicative constants.
dfs             a numeric vector with the degrees of freedom of each variance.
Details
The variances argument is mandatory while other arguments are optional. This function is automatically called by other functions from BivRegBLS package.

Value
A numeric variable with the degrees of freedom of the linear combination of the variances.

Author(s)
Bernard G FRANCQ

References
Welch BK. The generalization of "student's" problem when several different population variances are involved. Biometrika, 1947, 34: 28-35.

Examples
df.WS(variances=c(10,15,20),k=c(1.5,2,1.3),dfs=c(8,13,11))

DR
Deming Regression

Description
Estimate the Deming Regression (DR) with unreplicated or replicated data.

Usage
DR(data = NULL, xcol = 1, ycol = 2, ratio.var = NULL, conf.level = 0.95)

Arguments
data
xcol
ycol
ratio.var
conf.level
a data set (data frame or matrix).
a numeric vector to specify the X column(s) or a character vector with the column names.
a numeric vector to specify the Y column(s) or a character vector with the column names.
a numeric value for λ the ratio of the measurement error variances (Y over X) if known. Otherwise, it may be estimated with replicated data.
a numeric value for the confidence level (expressed between 0 and 1).
**Details**

The BLS regression is more general and includes the Deming Regression. The BLS regression provides more results and should, therefore, be used instead of DR.

**Value**

A list including the following elements:

- **Ellipse.DR**
  - A two columns matrix with the coordinates of the joint confidence interval (confidence region, ellipse) for the parameters ($\beta$, $\alpha$).

- **Estimate.DR**
  - A table (data frame) with the estimates of the intercept and the slope, standard error, confidence interval and pvalue (null hypothesis: slope = 1, intercept = 0). The exact confidence interval for the slope is also given.

**Author(s)**

Bernard G FRANCQ

**References**


**See Also**

BLS

**Examples**

```r
library(BivRegBLS)
data(SBP)
res.DR=DR(data=SBP,xcol=c("J1","J2","J3"),ycol=8:10)
res.DR$Estimate.DR
data(Aromatics)
res.DR=DR(data=Aromatics,xcol=3,ycol=4,ratio.var=2)
```

---

**Description**

Estimate the Correlated-Bivariate-Least Square regression (CBLS) for all potential solutions from $\rho_{MD}=-1$ to $\rho_{MD}=1$, in a (M,D) plot. This function is analogous to `FullCIs.XY` estimating all the BLS regressions from OLSv to OLSh in a (X,Y) plot.
Usage

FullCIs.MD(data = NULL, xcol = 1, ycol = 2,
    conf.level = 0.95, npoints = 1000, nlambdas = 13)

Arguments

data a data set (data frame or matrix).
xcol a numeric vector to specify the X column(s) or a character vector with the column names.
ycol a numeric vector to specify the Y column(s) or a character vector with the column names.
conf.level a numeric value for the confidence level (expressed between 0 and 1).
npoints a numeric variable for the number of points to smooth the hyperbolic curves.
nlambdas a numeric variable for the number of intermediate CBLS regressions (the two extreme CBLS are calculated by default).

Details

The data argument is mandatory. This function is especially useful for unreplicated data with unknown $\rho_{MD}$ (related to $\lambda_{XY}$, the ratio of the measurement error variances), as it calculates all the potential solutions. The different estimated regression lines are provided with the different confidence intervals.

Value

A CIs.MD class object, a list including the following elements:

Data.means a table with the X and Y data (means of the replicated data if replicated), their means and differences.

Ellipses.CB an array of dimension [npoints, 2 (intercept and slope), nlambdas + 2] with the coordinates of all the joint confidence intervals (confidence region, ellipses) from $\rho_{MD} = -1$ to $\rho_{MD} = 1$.

Slopes a table (nlambdas + 2 rows) with all the slopes estimates and their approximate confidence intervals and pvalue (slope = 0).

Intercepts a table (nlambdas + 2 rows) with all the intercepts estimates and their approximate confidence intervals and pvalue (intercept = 0).

Joints a table (nlambdas + 2 rows) with all the pvalues of the joint hypothesis (slope = 0 and intercept = 0).

Hyperbolic.intervals an array of dimension [npoints, 6 (X values, Y predictions, confidence interval and confidence bands), nlambdas + 2] with the hyperbolic confidence interval and confidence bands.

Author(s)

Bernard G FRANCQ
References
Francq BG, Govaerts BB. How to regress and predict in a Bland-Altman plot? Review and contribu-
tion based on tolerance intervals and correlated-errors-in-variables models. Statistics in Medicine,

See Also
FullCIs.XY, CBLS

Examples
library(BivRegBLS)
data(Aromatics)
res.full=FullCis.MD(data=Aromatics,xcol=3,ycol=4)

FullCis.XY

Confidence Intervals from OLSv to OLS by DR and BLS

Description
Estimate the vertical and horizontal Ordinary least Square regressions, and several 'intermediate'
Deming Regression (DR) and Bivariate Least Square (BLS), in a (X,Y) plot. The OLSv assumes
no error on the X axis (λ=Infinity), while the OLSb assumes no error on the Y axis (λ=0). These
two regressions are therefore 'extreme' regressions, while DR and BLS assume errors on both axes.

Usage
FullCis.XY(data = NULL, xcol = 1, ycol = 2,
conf.level = 0.95, npoints = 1000, nlambdas = 13)

Arguments
data a data set (data frame or matrix).
xcol a numeric vector to specify the X column(s) or a character vector with the column
names.
ycol a numeric vector to specify the Y column(s) or a character vector with the column
names.
conf.level a numeric value for the confidence level (expressed between 0 and 1).
npoints a numeric variable for the number of points to smooth the hyperbolic curves.
nlambdas a numeric variable for the number of intermediate DR and BLS regressions (be-
tween the OLSv and OLSb).

Details
The data argument is mandatory. This function is especially useful for unreplicated data with un-
known λ (the ratio of the measurement error variances), as it calculates all the potential solutions
from OLSv to OLSb. The different estimated regression lines are provided with the different confi-
dence intervals.
**Value**

A CIs.XY class object, a list including the following elements:

- **Data.means**: a table with the X and Y data (means of the replicated data if replicated).
- **Ellipses.CB**: an array of dimension \([npoints, 2 \text{ (intercept and slope)}, n\lambda + 2]\) with the coordinates of all the joint confidence intervals (confidence region, ellipses) from OLSv to OLS\(h\).
- **Slopes**: a table \((n\lambda + 2 \text{ rows})\) with all the slopes estimates from OLSv to OLS\(h\) including \(n\lambda\) intermediate values, the exact and approximate confidence intervals and pvalue (slope = 1).
- **Intercepts**: a table \((n\lambda + 2 \text{ rows})\) with all the intercepts estimates from OLSv to OLS\(h\) including \(n\lambda\) intermediate values, the approximate confidence intervals and pvalue (intercept = 0).
- **Joints**: a table \((n\lambda + 2 \text{ rows})\) with all the pvalues of the joint hypothesis (slope = 1 and intercept = 0) from OLSv to OLS\(h\) including intermediate \(n\lambda\) values.
- **Hyperbolic.intervals**: an array of dimension \([npoints, 6 \text{ (X values, Y predictions, confidence interval and confidence bands)}, n\lambda + 2]\) with the hyperbolic confidence intervals and confidence bands from OLSv to OLS\(h\) including \(n\lambda\) intermediate values.

**Author(s)**

Bernard G FRANCIQ

**References**


**See Also**

*FullCIs.MD, BLS*

**Examples**

```r
library(BivRegBLS)
data(Aromatics)
res.full=FullCIs.XY(data=Aromatics,xcol=3,ycol=4)
```
Plot all the CBLS potential solutions

Description
Display a plot with all the CBLS potential solutions in a (M,D) plot from $\rho_{MD} = -1$ to $\rho_{MD} = 1$ (useful for unreplicated data), choose between all the slopes (and their confidence intervals), all the intercepts (and their confidence intervals), all the confidence regions (ellipses), the two extreme confidence intervals (for the expectation of Y) or the two extreme confidence bands.

Usage
```
GraphFullCIs.MD(FullCIs = NULL, CBLS.estimate = NULL, lambda = NULL,
               xname = "X", yname = "Y", antilog = NULL, graph = "joint.ellipse",
               accept.int = 0, accept.int.perc = FALSE, accept.int.threshold = NULL,
               include.H0 = TRUE, include.int = TRUE)
```

Arguments
- **FullCIs** a CIs.MD class object.
- **CBLS.estimate** a CBLS class object. The CBLS estimates (obtained, for example, with replicated data) will be superimposed on the plot.
- **lambda** a lambdas class object. The value of $\lambda$ (ratio of the error measurement variances) will be converted to $\rho$ (correlation between the error measurement) and superimposed on the plot with its confidence interval.
- **xname** a character string for the name of the X device.
- **yname** a character string for the name of the Y device.
- **antilog** a character string or a numeric value. This argument displays the CBLS results on the initial scales on the (M,D) plot if a logarithmic transformation was used prior to the CBLS function. Options available are: 10 or "e".
- **graph** a character string for the type of graph: "slope" to plot all the slopes, "intercept" to plot all the intercepts,"joint.ellipse" to plot all the joint confidence intervals (ellipses), "CI" to plot the confidence intervals,"CB" to plot the confidence bands,"all" to plot all the plots on different windows.
- **accept.int** a numeric vector (length equal 1 or 2) for the value of $\Delta$: $|Y-X|<\Delta$ to assess whether two devices (X and Y) are equivalent or not. Two values of $\Delta$ can be entered to take into account the case where the equivalence threshold changes along the M axis.
- **accept.int.perc** a logical variable (True or False) whether $\Delta$ needs to be interpreted in percentage: $Y = X \pm \Delta \%$.
- **accept.int.threshold** a numeric value for the M threshold where the value of $\Delta$ changes if two $\Delta$ values are used in accept.int.
include.H0  a logical variable (True or False) whether the null hypothesis (slope = 0, intercept = 0) should lie on plot (in the case that the null hypothesis is out from the axes limits).

include.int  a logical variable (True or False) whether the confidence intervals should lie entirely in the plot.

Details

The ellipses are plotted in an ($\beta,\alpha$) coordinate system where the acceptance interval is a diamond. The slopes and the intercepts are plotted on the Y-axis with $\rho_{MD}$ assigned on the X-axis. The confidence intervals and confidence bands are displayed on a (M,D) plot (Bland-Altman plot).

Value

The plot requested by the argument graph.

Author(s)
Bernard G FRANCQ

References


See Also

MD.plot,CBLS

Examples

library(BivRegBLS)
data(SBP)

# Estimate all the solutions with the CBLS regression
res.full=FullCIs.MD(data=SBP,xcol=c("J1","J2","J3"),ycol=8:10)
# Estimate the CBLS regression with replicated data
res.CBLS=CBLs(data=SBP,xcol=c("J1","J2","J3"),ycol=8:10)
# Estimate the measurement error variances ratio
res.lambda=lambdaS(data=SBP,xcol=c("J1","J2","J3"),ycol=8:10)
# Plot all the results with all the potential solutions
# and superimpose the CBLS regression estimated with replicated data
GraphFullCIs.MD(FullCIs=res.full,CBLS=estimate(res.CBLS),lambda=res.lambda, xname="J",yname="S",graph="all",accept.int=10,accept.int.perc=FALSE,include.H0=TRUE)
data(Aromatics)
GraphFullCIs.XY

Plot all the DR and BLS potential solutions

Description

Display a plot with all the DR and BLS potential solutions from OLSv to OLSh (useful for unrepli-
cated data), choose between all the slopes (and their confidence intervals), all the intercepts (and
their confidence intervals), all the confidence region (ellipses), the two extreme confidence intervals
(for the expectation of Y) or the two extreme confidence bands.

Usage

```r
GraphFullCIs.XY(NullCIs = NULL, BLS.estimate = NULL, lambda = NULL,
   xname = "X", yname = "Y", antilog = NULL, graph = "joint.ellipse",
   accept.int = 0, accept.int.perc = FALSE, accept.int.threshold = NULL,
   include.H0 = TRUE, include.int = TRUE)
```

Arguments

- **FullCIs**: a CIs.XY class object.
- **BLS.estimate**: a BLS class object. The BLS estimates (obtained, for example, with replicated
data) will be superimposed on the plot.
- **lambda**: a lambdas class object. The value of $\lambda_{XY}$ will be superimposed on the plot with
its confidence interval.
- **xname**: a character string for the name of the X device.
- **yname**: a character string for the name of the Y device.
- **antilog**: a character string or a numeric value. This argument displays the BLS results
on the initial scales on the (X,Y) plot if a logarithmic transformation was used
prior to the BLS function. Options available are: 10 or "e".
- **graph**: a character string for the type of graph: "slope" to plot all the slopes, "inter-
cet" to plot all the intercepts,"joint.ellipse" to plot all the joint confidence inter-
vals (ellipses), "CI" to plot the confidence intervals,"CB" to plot the confidence
bands, "all" to plot all the plots on different windows.
- **accept.int**: a numeric vector (length equal 1 or 2) for the value of $\Delta$: $Y = X \pm \Delta$ to assess
whether the two devices (X and Y) are equivalent or not. Two values of $\Delta$ can
be entered to take into account the case where the equivalence threshold changes
along the X axis.
accept.int.perc
    a logical variable (True or False) whether $\Delta$ needs to be interpreted in percentage: $Y = X \pm \Delta\%$.

accept.int.threshold
    a numeric value for the X threshold where the value of $\Delta$ changes if two $\Delta$ values are used in accept.int

include.H0
    a logical variable (True or False) whether the null hypothesis (slope = 1, intercept = 0) should lie on plot (in the case that the null hypothesis is out from the axes limits).

include.int
    a logical variable (True or False) whether the confidence intervals should lie entirely in the plot.

Details
    The ellipses are plotted in an ($\beta, \alpha$) coordinate system where the acceptance interval is a diamond. The slopes and the intercepts are plotted on the Y-axis with $\lambda_{XY}$ assigned on the X-axis. The confidence intervals and confidence bands are displayed on a classical (X,Y) plot.

Value
    The plot requested by the argument graph.

Author(s)
    Bernard G FRANCOQ

References

See Also
    XY.plot, BLS

Examples
    library(BivRegBLs)
    data(SBP)
    # Estimate all the solutions with the DR and BLS regressions
    res.full=FullCIs.XY(data=SBP,xcol=c("J1","J2","J3"),ycol=8:10)
    # Estimate the BLS regression with replicated data
    res.BLS=BLs(data=SBP,xcol=c("J1","J2","J3"),ycol=8:10)
    # Estimate the measurement error variances ratio
    res.lambda=lambda(data=SBP,xcol=c("J1","J2","J3"),ycol=8:10)
    # Plot all the results with all the potential solutions
# and superimpose the BLS regression estimated with replicated data
GraphFullCIs.XY(FullCIs=res.full,BLS.estimate=res.BLS,lambdas=res.lambda, xname="J",yname="S",graph="all",accept.int=10,accept.int_perc=FALSE,include.H0=TRUE)
# Plot all the potential solutions for the confidence intervals and add two acceptance intervals
GraphFullCis.XY(FullCIs=res.full,xname="J",yname="S",graph="CI", accept.int=c(8,12),accept.int.threshold=150,accept.int_perc=FALSE,include.H0=TRUE)
data(Aromatics)
# Estimate all the solutions with the BLS regression
res.full=FullCIs.XY(data=Aromatics,xcol=3,ycol=4)
# Plot all the potential solutions for the confidence regions (ellipses)
GraphFullCIs.XY(FullCis=res.full,xname="HPLC",yname="GC MS",graph="joint.ellipse")

---

**Description**

Calculate the measurement error variances ratio of two devices (Y over X): \( \lambda \) and \( \lambda_{XY} \).

**Usage**

```r
lambdas(data = NULL, xcol = NULL, ycol = NULL, conf.level = 0.95)
```

**Arguments**

- **data**: a data set (data frame or matrix).
- **xcol**: a numeric vector to specify the X columns or a character vector with the column names.
- **ycol**: a numeric vector to specify the Y columns or a character vector with the column names.
- **conf.level**: a numeric value for the confidence level.

**Details**

The data must be replicated to estimate the measurement error variances. If the number of replicates in X is equal to the number of replicates in Y, then \( \lambda \) and \( \lambda_{XY} \) are equal: \( \lambda \) is the ratio (Y over X) of the measurement error variances, while \( \lambda_{XY} \) is similar but takes also into account the number of replicates per device (\( nx \) and \( ny \)). Unbiased estimators (which is not the ratio of the two variances) for \( \lambda \) and \( \lambda_{XY} \) are also given.

**Value**

A lambdas class object, a table with 2 rows (\( \lambda \) and \( \lambda_{XY} \)) and their confidence intervals and p-values in columns (the null hypothesized value is 1).

**Author(s)**

Bernard G FRANCQ
MD.horiz.lines

References

See Also
desc.stat

Examples
library(BivRegBLS)
data(SBP)
lambdas(data=SBP,xcol=c("J1","J2","J3"),ycol=8:10)

MD.horiz.lines Tolerance intervals in a (M,D) plot

Description
Calculate agreement interval and tolerance intervals (bounded by 2 horizontal lines) for the differences (D=Y-X) in a (M,D) plot (also called Bland-Altman plot).

Usage
MD.horiz.lines(data = NULL, xcol = 1, ycol = 2,
pred.level = 0.95, TI.conf.level = 0.8)

Arguments
data a data set (data frame or matrix).
xcol a numeric vector to specify the X column(s) or a character vector with the column names.
ycol a numeric vector to specify the Y column(s) or a character vector with the column names.
pred.level a numeric value for the predictive level (expressed between 0 and 1) of the tolerance intervals (beta expectation (type I) and beta gamma content (type II)).
TI.conf.level a numeric value for the confidence level of the beta gamma content tolerance interval (tolerance interval type II).
Details

The data argument is mandatory while other arguments are optional. If the data are replicated, the tolerance intervals predict where a future single difference \( (D_i = Y_i - X_i) \) will lie (and not an average difference). Tolerance intervals are better (than agreement interval) and should be preferred. The tolerance intervals are calculated on the univariate distribution of the differences \( (D_i) \). These intervals are valid under the assumption that there is no proportional bias. If a pattern is observed, the CBLS function (CBLS regression) must be used (with its predictive intervals).

Value

A MD.horiz.lines class object: a list including the following elements:

- **data.MD**
  - A table with the means \( ((X+Y)/2) \) and differences \( (Y-X) \).

- **Table.Differences**
  - A table with one row and several descriptive statistics: the mean of the differences, the standard deviation of the mean difference \( (D_i = Y_i - X_i) \) and the standard deviation for a single difference \( (Y_{ik} - X_{ik}) \), the minimum, 1st quartile, median, 3rd quartile, maximum and number of observations.

- **Intervals.horiz.lines**
  - A table with 3 rows for the agreement interval, the beta expectation tolerance interval and the beta gamma content tolerance interval, with their interpretation (columns).

Author(s)

Bernard G FRANCQ

References


See Also

CBLS

Examples

```r
library(BivRegBLS)
data(SBP)
res.MD.horiz=MD.horiz.lines(data=SBP,xcol=c("J1","J2","J3"),ycol=8:10,pred.level=0.95)
res.MD.horiz$Intervals.horiz.lines
```
Display the CBLS regression, or univariate tolerance intervals in a (M,D) plot

Description

Display the CBLS regression in a (M,D) plot with or without hyperbolic confidence and/or predictive intervals, and an acceptance interval. Alternatively, univariate tolerance intervals which are bounded by two horizontal lines can be plotted.

Usage

```r
MD.plot(results = NULL, xname = "X", yname = "Y", antilog = NULL,
accept.int = 0, accept.int.perc = FALSE, accept.int.threshold = NULL,
include.int = TRUE, graph.int = c("CI", "PI"), graph.horiz.int = c("bTI", "bgTI"),
col.CBLS = 1, col.CI = 2, col.CB = 3, col.PI = 4, col.GI = 5, col.bTI = 3,
col.bgTI = 4, lty.CBLS = 1, lty.CI = 1, lty.CB = 1, lty.PI = 1, lty.GI = 1,
lty.bTI = 1, lty.bgTI = 1, ...)
```

Arguments

- **results**: a CBLS class object (obtained with the `bls` function) or a MD.horiz.lines class object (obtained with the `MD.horiz.lines` function).
- **xname**: a character string for the name of the X device.
- **yname**: a character string for the name of the Y device.
- **antilog**: a character string or a numeric value. This argument displays the CBLS or MD.horiz.lines results on the initial scales in the (M,D) plot if a logarithmic transformation was used prior to the CBLS or MD.horiz.lines functions. Options available are: 10 or "e".
- **accept.int**: a numeric vector (length equal 1 or 2) for the value of $\Delta$: |Y-X|<$\Delta$ to assess whether two devices (X and Y) are equivalent or not. Two values of $\Delta$ can be entered to take into account the case where the equivalence threshold changes along the M axis.
- **accept.int.perc**: a logical variable (True or False) whether $\Delta$ needs to be interpreted in percentage: $Y = X \pm \Delta\%$.
- **accept.int.threshold**: a numeric value for the M threshold where the value of $\Delta$ changes if two $\Delta$ values are used in accept.int.
- **include.int**: a logical variable (True or False) whether the hyperbolic intervals should lie entirely in the plot.
- **graph.int**: a character vector for the hyperbolic curves to be displayed on the graph. Options are: "CI" (Confidence Intervals),"CB" (Confidence Bands),"PI" (Predictive Intervals),"GI" (Generalised Intervals).
graph.horiz.int

if a MD.horiz.lines object is used, a character vector for the univariate tolerance intervals to be displayed on the graph. Options are: "bTI" (beta expectation tolerance interval or tolerance interval type I) and/or "bgTI" (beta gamma content tolerance interval or tolerance interval type II).

col.CBLS a character string or a numeric variable for the colour of the CBLS regression line.
col.CI a character string or a numeric variable for the colour of the confidence intervals.
col.CB a character string or a numeric variable for the colour of the confidence bands.
col.PI a character string or a numeric variable for the colour of the predictive intervals.
col.GI a character string or a numeric variable for the colour of the generalized intervals.
col.bTI a character string or a numeric variable for the colour of the beta expectation tolerance interval.
col.bgTI a character string or a numeric variable for the colour of the beta gamma content tolerance interval.
lty.CBLS a numeric variable for the type of line of the CBLS regression line.
lty.CI a numeric variable for the type of line for the confidence intervals.
lty.CB a numeric variable for the type of line for the confidence bands.
lty.PI a numeric variable for the type of line for the predictive intervals.
lty.GI a numeric variable for the type of line for the generalized intervals.
lty.bTI a numeric variable for the type of line for the beta expectation tolerance interval.
lty.bgTI a numeric variable for the type of line for the beta gamma content tolerance interval.

... the common arguments from 'plot' or 'par' that may be used additionaly, such as xlim, ylim, xlab, ylab.

Details

The results argument is mandatory. The value of $\Delta$ (accept.int) is converted to percentage if antilog is used in a (M,D) plot to define 2 asymmetric bounds $(1 - \Delta/100, (100/(100-\Delta))$.

Value

An (M,D) plot in a new window.

Note

The limits of the axes and their labels are set automatically by the function. To compare different plots with fixed limits, use xlim and ylim. To write customized labels, use xlab and ylab.

Author(s)

Bernard G FRANCO
References

See Also
XY.plot

Examples
library(BivRegBLS)
data(Hsbp)
# Estimate the CBLS regression on replicated data
res.CBLS=CBLS(data=SBP,xcol=c("J1","J2","J3"),ycol=8:10)
# Plot the results in a (M,D) plot with an acceptance interval
MD.plot(results=res.CBLS,xname="J",yname="S",accept.int=10,accept.int.perc=FALSE)
MD.plot(results=res.CBLS,xname="J",yname="S",accept.int=10,accept.int.perc=TRUE)
MD.plot(results=res.CBLS,xname="J",yname="S",accept.int=c(10,15),
        accept.int.perc=FALSE,accept.int.threshold=150)

OLSh

Horizontal Ordinary Least Square regression

Description
Fit a linear ordinary least square regression by minimising the residuals in a horizontal direction.

Usage
OLSh(data = NULL, xcol = 1, ycol = 2, conf.level = 0.95)

Arguments
data a data set (data frame or matrix).
xcol a numeric vector to specify the X columns or a character vector with the column names.
ycol a numeric vector to specify the Y columns or a character vector with the column names.
conf.level a numeric value for the confidence level (expressed between 0 and 1).

Details
The data argument is mandatory while other arguments are optional.
Value

A list including the following elements:

- **Ellipse.OLSh**: a two columns matrix with the coordinates of the joint confidence interval (confidence region) for the parameters $(\beta, \alpha)$.
- **Estimate.OLSh**: a table (data frame) with the estimates of the intercept and the slope, standard error, confidence interval and p-value (null hypothesis: slope = 1, intercept = 0).

Note

The default value for xcol (ycol) is 1 (2) for the 1st (2nd) column. The confidence region for the OLSv parameters is 'distorted' as it results from the OLSv confidence region (ellipse).

Author(s)

Bernard G FRANCQ

References


See Also

- **OLSv**

Examples

```r
res.OLSh=OLSh(matrix(nrow=10,ncol=2,c((1:10)+rnorm(10),1:10)))
res.OLSh$Estimate.OLSh
```

---

**OLSv**

*Vertical Ordinary Least Square regression*

Description

Fit a linear ordinary least square regression by minimising the residuals in a vertical direction.

Usage

```r
OLSv(data = NULL, xcol = 1, ycol = 2, conf.level = 0.95, pred.level = 0.95, npoints = 1000, q = 1, xpred = NULL)
```
Arguments

- **data**: a data set (data frame or matrix).
- **xcol**: a numeric vector to specify the X column(s) or a character vector with the column names.
- **ycol**: a numeric vector to specify the Y column(s) or a character vector with the column names.
- **conf.level**: a numeric value for the confidence level (expressed between 0 and 1).
- **pred.level**: a numeric value for the predictive level (expressed between 0 and 1).
- **npoints**: a numeric variable for the number of points to smooth the hyperbolic curves.
- **q**: a numeric value to predict the mean of q future values (generalized interval).
- **xpred**: a numeric vector for customized predictions at given X values.

Details

The data argument is mandatory while other arguments are optional. The confidence level is used for the confidence intervals of the parameters, the hyperbolic confidence intervals (the prediction of the expectation of Y for a given X) and the hyperbolic confidence bands. The predictive level is used for the hyperbolic predictive intervals (the prediction of a future Y for a given X) and the hyperbolic generalized intervals (the prediction of the mean of q future Y values for a given X).

Value

A list including the following elements:

- **Ellipse.OLSv**: a two columns matrix with the coordinates of the joint confidence interval (confidence region, ellipse) for the parameters ($\beta$, $\alpha$).
- **Estimate.OLSv**: a table (data frame) with the estimates of the intercept and the slope, standard error, confidence interval and pvalue (null hypothesis: slope = 1, intercept = 0).
- **Pred.OLSv**: a data frame with npoints rows (from the minimum to the maximum of the observed X values) and the following columns: the X values where the predictions are calculated (X0), the Y predicted values (Ypred), the lower and upper bounds of the confidence intervals, predictive intervals, generalized intervals and confidence bands.
- **xpred.OLSv**: a data frame with the customized predictions and the same columns than Pred.OLSv.

Note

The default value for xcol (ycol) is 1 (2) for the 1st (2nd) column.

Author(s)

Bernard G FRANCQ
References

See Also
OLSh

Examples
```
res.OLSh=OLSv(matrix(nrow=10,ncol=2,c(1:10,(1:10)+rnorm(10))))
res.OLSh$Estimate.OLSh
```

---

**raw.plot**

*Raw plot for descriptive statistics*

**Description**
Display a plot with the raw data in an (X,Y) plot or (M,D) plot with or without error bars.

**Usage**
```
raw.plot(data.plot = NULL, xname = "X", yname = "Y", graph = "XY.means",
         col.ID = NULL, pch.ID = NULL, ...)
```

**Arguments**
- **data.plot** a desc.stat class object (obtained by using the desc.stat function).
- **xname** a character string for the name of the X device.
- **yname** a character string for the name of the Y device.
- **graph** a character string for the kind of graph. Options available are: XY.means, XY.points, XY.bar.range, XY.bar.SEM, XY.bar.SD, MD.means.
- **col.ID** a numeric or character vector describing the color of the points per ID.
- **pch.ID** a numeric vector describing the type of points per ID to plot the data.
- **...** the common arguments from 'plot' or 'par' that may be used additionally, such as xlim, ylim, xlab, ylab.
Details

The `data.plot` argument is mandatory. The labels of the X and Y axes are built by default with `xname` and `yname`, and with the type of graph `graph`. The arguments `col.ID` and `pch.ID` are useful if the argument `IDcol` was used in the function `desc.stat`. `col.ID` and `pch.ID` are recycled if shorter than the number of IDs, i.e. if 3 colors are specified as `col.ID=c(1,2,3)` while there are 7 IDs, then the colors will be used as `c(1,2,3,1,2,3,1)`. With the argument `graph`, the option `XY.means` plots the mean measures in a (X,Y) plot, `XY.points` plots all the X (Y) replicated data centered on the means of Y (X), `XY.bar.range` plots the error bars from the minimum to the maximum (the range) of the replicates, `XY.bar.SEM` plots the error bars with the standard errors of the means, `XY.bar.SD` plots the error bars with the standard deviations, `MD.means` plots the mean measures in a (M,D) plot.

Value

A plot in a new window.

Note

The limits of the axes and the labels are set automatically by the function. To compare different plots with fixed limits, use `xlim` and `ylim`. To write customized labels, use `xlab` and `ylab`.

Author(s)

Bernard G FRANCQ

References


See Also

`XY.plot`, `MD.plot`

Examples

```r
calculate the descriptive statistics
data(Aromatics)
res=desc.stat(data=Aromatics,xcol=3,ycol=4,IDcol="Type")

# Plot the mean or single measures (it is the same for unreplicated data)
raw.plot(data.plot=res,xname="HPLC",yname="GC MS",graph="XY.means")
raw.plot(data.plot=res,xname="HPLC",yname="GC MS",graph="XY.points")

# Plot with customized colours and type of points per type of samples
raw.plot(data.plot=res,xname="HPLC",yname="GC MS",graph="XY.points",pch.ID=c(19,5,8),col.ID=c(1,2))
raw.plot(data.plot=res,xname="HPLC",yname="GC MS",graph="MD.means")
raw.plot(data.plot=res,xname="HPLC",yname="GC MS",graph="MD.means",col.ID=c(1,2,4))
data(SBP)

# Calculate the descriptive statistics
```
SBP

Systolic blood pressure data

Description

Systolic blood pressure measured by two devices on 85 patients: 3 times with a manual device by 2 operators and 3 times with a semi automatic device.

Usage

data(SBP)

Format

A data frame with 85 observations and 10 variables.

Subject a numeric vector for the patient IDs.
J1 a numeric vector: the 1st measures obtained by operator J.
J2 a numeric vector: the 2nd measures obtained by operator J.
J3 a numeric vector: the 3rd measures obtained by operator J.
R1 a numeric vector: the 1st measures obtained by operator R.
R2 a numeric vector: the 2nd measures obtained by operator R.
R3 a numeric vector: the 3rd measures obtained by operator R.
S1 a numeric vector: the 1st measures obtained by the semi automatic device.
S2 a numeric vector: the 2nd measures obtained by the semi automatic device.
S3 a numeric vector: the 3rd measures obtained by the semi automatic device.

Source

XY.plot

References

Examples
data(SBP)
str(SBP)
head(SBP)

---

XY.plot

Display the BLS regression in a (X,Y) plot

Description
Display the BLS regression in a (X,Y) plot with or without hyperbolic confidence and/or predictive intervals, and an acceptance interval.

Usage
XY.plot(BLS.results = NULL, xname = "X", yname = "Y", antilog = NULL,
accept.int = 0, accept.int.perc = FALSE, accept.int.threshold = NULL,
graph.int = c("CB", "PI"), include.int = FALSE, col.BLS = 1, col.CI = 2,
col.CB = 3, col.PI = 4, col.GI = 5, lty.BLS = 1, lty.CI = 1,
lty.CB = 1, lty.PI = 1, lty.GI = 1, ...)

Arguments
BLs.results a BLS or BLS.ht class object (obtained with the BLS or BLS.ht functions).
xname a character string for the name of the X device.
yname a character string for the name of the Y device.
antilog a character string or a numeric value. This argument display the BLS results on the initial scales on the (X,Y) plot if a logarithmic transformation was used prior to the BLS function. Options available are: 10 or "e".
accept.int a numeric vector (length equal 1 or 2) for the value of Δ: Y = X ± Δ to assess whether two devices (X and Y) are equivalent or not. Two values of Δ can be entered to take into account the case where the equivalence threshold changes along the X axis.
accept.int.perc a logical variable (True or False) whether Δ needs to be interpreted in percentage: Y = X ± Δ %.
accept.int.threshold
a numeric value for the X threshold where the value of $\Delta$ changes if two $\Delta$
values are used in accept.int.

graph.int
a character vector for the hyperbolic curves to be displayed on the graph. Options are: "CI" (Confidence Intervals), "CB" (Confidence Bands), "PI" (Predictive Intervals), "GI" (Generalised Intervals).

include.int
a logical variable whether the hyperbolic intervals should lie entirely in the plot.

col.BLS
a character string or a numeric variable for the colour of the BLS regression line.

col.CI
a character string or a numeric variable for the colour of the confidence intervals.

col.CB
a character string or a numeric variable for the colour of the confidence bands.

col.PI
a character string or a numeric variable for the colour of the predictive intervals.

col.GI
a character string or a numeric variable for the colour of the generalized intervals.

lty.BLS
a numeric variable for the type of line of the BLS regression line.

lty.CI
a numeric variable for the type of line for the confidence intervals.

lty.CB
a numeric variable for the type of line for the confidence bands.

lty.PI
a numeric variable for the type of line for the predictive intervals.

lty.GI
a numeric variable for the type of line for the generalized intervals.

... the common arguments from 'plot' or 'par' that may be used additionaly, such as xlim, ylim, xlab, ylab.

Details
The BLS.result argument is mandatory.

Value
An (X,Y) plot in a new window.

Note
The limits of the axes and their labels are set automatically by the function. To compare different plots with fixed limits, use xlim and ylim. To write customized labels, use xlab and ylab.

Author(s)
Bernard G FRANCQ

References

See Also

MD.plot

Examples

```r
library(BivRegBLS)
data(SBP)
# Estimate the BLS regression on replicated data
res.BLS=BLS(data=SBP,xcol=c("J1","J2","J3"),ycol=8:10,qx=3,qy=3)
# Plot the results in a (X,Y) plot with an acceptance interval
XY.plot(BLS.results=res.BLS,xname="J",yname="S",accept.int=10,accept.int.perc=FALSE)
XY.plot(BLS.results=res.BLS,xname="J",yname="S",accept.int=10,accept.int.perc=TRUE)
XY.plot(BLS.results=res.BLS,xname="J",yname="S",accept.int=c(10,20),
        accept.int.perc=FALSE,accept.int.threshold=150)
```
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