Package 'MethodCompare'

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Type Package

Title Bias and Precision Plots

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Description Implementation of the methodology from the paper entitled
``Effective plots to assess bias and precision in method comparison studies''
published in Statistical Methods in Medical Re-
search, P. Taffé (2018) <doi:10.1177/0962280218759693>.

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R topics documented:

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bias_plot   *Bias plot*

Description

This function draws the "bias plot", which is used to visually assess the bias of the new method relative to the reference method. It is obtained by graphing a scatter plot of y1 (new method) and y2 (reference method) versus the BLUP of y2 along with the two regression lines, and adds a second scale on the right axis showing the relationship between the estimated amount of bias and BLUP of y2.

Usage

```
bias_plot(object)
```

Arguments

object   an object returned by a call to measure_compare

Author(s)

Mingkai Peng & Patrick Taffé

Examples

```
### load the data
data(data1)
### analysis
measure_model <- measure_compare(data1)
### Bias plot
bias_plot(measure_model)
```

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bland_altman_plot   *Extended Bland-Atlman limits of agreement (LoA) plot*

Description

This function produces the extended Bland-Altman Limits of Agreement (LoA) plot when there are repeated measurements with possibly heteroscedastic variance of measurement errors.

Usage

```
bland_altman_plot(data, new = "y1", Ref = "y2", ID = "id", fill = TRUE)
```

Arguments

`data`	a dataframe contains the object identification number (id), the measurement values from the new measurement method (y1) and those from the reference standard (y2)
`new`	specify the variable name or location for the new measurement method
`Ref`	specify the variable name or location for the reference measuerment method
`ID`	specify the variable name for location for the subject identification number (id)
`fill`	logical. if `TRUE` use the average value for new methods to fill out the missing value (only useful for drawing a plot with all the measurements by the reference standard)

Details

This functions computes the limits of agreement (LoA) when there are repeated measurements and possibly heteroscedastic variance of measurement errors

Author(s)

Mingkai Peng & Patrick Taffé

Examples

```
### Load the data
data(data1)
### Bland and Altman's plot
bland_altman_plot(data1)
```

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compare_plot   *Comparison plot*

Description

This function allows the visualization of the bias-corrected values (i.e. recalibrated values, variable y1_corr) of the new measurement method.

Usage

```
compare_plot(object)
```

Arguments

`object`	an object returned by a call to [measure_compare](#)

Author(s)

Mingkai Peng & Patrick Taffé

Examples

```
### load the data
data(data1)
### analysis
measure_model <- measure_compare(data1)
### compare plot
compare_plot(measure_model)
```

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data1   *Simulated dataset 1*

Description

In the simulated dataset 1, each subject has 1 measurement value from the new method and 10 to 15 measurement values from the reference method. Compared to the reference method, the new method has differential bias of -4 and proportional bias of 1.2. Variance of the new method is smaller than that for the reference method.

Usage

```
data1
```

Format

An object of class data.frame with 1255 rows and 3 columns.

Details

A data frame with three variables:

id identification number for subjects

y1 values from the new measurement method

y2 values from the reference measurement method

Dataset 1 was created based on the following equations:

$$y_{1i} = -4 + 1.2x_i + \varepsilon_{1i}, \varepsilon_{1i} \mid x_i \sim N(0, (1 + 0.1x_i)^2)$$

$$y_{2ij} = x_i + \varepsilon_{2ij}, \varepsilon_{2ij} \mid x_i \sim N(0, (2 + 0.2x_i)^2)$$

$$x_i \sim Uniform[10 - 40]$$

for $i = 1, 2, \ldots, 100$, $j = 1, 2, \ldots, n_{2i}$ and the number of repeated measurements for each subject i from the reference standard was $n_{2i} \sim Uniform[10 - 15]$.

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data2   *Simulated dataset 2*

Description

In the simulated dataset 2, each subject has 1 to 5 measurement values from the new method and 10 to 15 measurement values from the reference method. Compared to the reference method, the new method has differential bias of -4 and proportional bias of 1.2. Variance of the new method is smaller than that for the reference method.

Usage

```
data2
```

Format

An object of class data.frame with 1239 rows and 3 columns.

Details

@format A data frame with three variables:

id identification number for subjects

y1 values from the new measurement method

y2 values from the reference measurement method

Dataset 2 was created based on the following equations:

$$y_{1ij} = -4 + 1.2x_i + \varepsilon_{1ij}, \varepsilon_{1ij} \mid x_i \sim N(0, (1 + 0.1x_i)^2)$$

$$y_{2ij} = x_i + \varepsilon_{2ij}, \varepsilon_{2ij} \mid x_i \sim N(0, (2 + 0.2x_i)^2)$$

$$x_i \sim Uniform[10 - 40]$$

for $i = 1, 2, \ldots, 100$, $j = 1, 2, \ldots, n_{1i}/n_{2i}$ and the number of repeated measurements for each subject i from the new and reference method was $n_{1i} \sim Uniform[1-5]$ and $n_{2i} \sim Uniform[10-15]$ respectively.

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data3   *Simulated dataset 3*

Description

In the simulated dataset 3, each subject has 1 to 5 measurement values from the new method and 10 to 15 measurement values from the reference method. Compared to the reference method, the new method has differential bias of 3 and proportional bias of 0.9. Variance of the new method is larger than that for the reference method.

Usage

```
data3
```

Format

An object of class data.frame with 1250 rows and 3 columns.

Details

@format A data frame with three variables:

id identification number for subjects

y1 values from the new measurement method

y2 values from the reference measurement method

Dataset 3 was created based on the following equations:

$$y_{1ij} = 3 + 0.9x_i + \varepsilon_{1ij}, \varepsilon_{1ij} \mid x_i \sim N(0, (2 + 0.06x_i)^2)$$

$$y_{2ij} = x_i + \varepsilon_{2ij}, \varepsilon_{2ij} \mid x_i \sim N(0, (1 + 0.01x_i)^2)$$

$$x_i \sim Uniform[10 - 40]$$

for $i = 1, 2, \ldots, 100$, $j = 1, 2, \ldots, n_{1i}/n_{2i}$ and the number of repeated measurements for each subject i from the new and reference method was $n_{1i} \sim Uniform[1-5]$ and $n_{2i} \sim Uniform[10-15]$ respectively.

measure_compare	*Estimation of the amount of bias of the new measurement method relative to the reference method, with possibly heteroscedastic variance of the measurement errors*

Description

This function implements the methodology reported in the paper: Taffé P. Effective plots to assess bias and precision in method comparison studies. Stat Methods Med Res 2018;27:1650-1660. Other relevant references: Taffé P, Peng M, Stagg V, Williamson T. Biasplot: A package to effective plots to assess bias and precision in method comparison studies. Stata J 2017;17:208-221. Taffé P, Peng M, Stagg V, Williamson T. MethodCompare: An R package to assess bias and precision in method comparison studies. Stat Methods Med Res 2019;28:2557-2565. Taffé P, Halfon P, Halfon M. A new statistical methodology to assess bias and precision overcomes the defects of the Bland & Altman method. J Clin Epidemiol 2020;124:1-7. Taffé P. Assessing bias, precision, and agreement in method comparison studies. Stat Methods Med Res 2020;29:778-796. Taffé P. When can the Bland-Altman limits of agreement method be used and when it should not be used. J Clin Epidemiol 2021; 137:176-181.

Usage

```
measure_compare(data, new = "y1", Ref = "y2", ID = "id")
```

Arguments

data	a dataframe containing the identification number of the subject (id), the measurement values from the new measurement method (y1) and those from the reference method).
new	specify the variable name or location of the new measurement method
Ref	specify the variable name or location of the reference standard
ID	specify the variable name for location of the subject identification number

Details

This functions implements the new estimation procedure to assess bias and precision of a new measurement method with respect to a reference standard, as well as Bland & Altman's limits of agreement extended to the setting of possibly heteroscedastic variance of the measurement errors.

Value

The function returns a list with the following items:

- Bias: differential and proportional bias for new method and the associated 95 percent confidence intervals
- Models: list of models fitted in estimation procedure

- Ref: a data frame containing the various variables used to compute the bias and precision plots, as well the smooth standard errors estimates of the reference standard
- New: a data frame containing the various variables used to compute the bias and precision plots, as well the smooth standard errors estimates of the new measurement method

Author(s)

Mingkai Peng & Patrick Taffé

Examples

```
### Load the data
data(data1)
### Analysis
measure_model <- measure_compare(data1)
```

MethodCompare   *MethodCompare*

Description

The package "MethodCompare" allows one to assess bias and precision of a new measurement method with respect to a reference method (also called "reference standard"). It requires repeated measurements by at least one of the two measurement methods.

In this implementation, it is assumed by default that the reference method has repeated measurements and the new method may have as few as only one measurement per individual (The methodology can be adapted if you have more repeated measurements by the new method than by the reference method, see ref. below).

A manuscript with details concerning the methodology and its application can be found:

<doi:10.1177/0962280218759693>

It implements the methodology developped in:

Taffé P. Effective plots to assess bias and precision in method comparison studies. Stat Methods Med Res 2018;27:1650-1660.

NB: Further methodological developpements have been made and will be implemented in a future version of the package:

Taffé P. Assessing bias, precision, and agreement in method comparison studies. Stat Methods Med Res 2020;29:778-796. doi:10.1177/0962280218759693

For other relevant references:

Taffé P, Peng M, Stagg V, Williamson T. Biasplot: A package to effective plots to assess bias and precision in method comparison studies. Stata J 2017;17:208-221.

Taffé P, Peng M, Stagg V, Williamson T. MethodCompare: An R package to assess bias and precision in method comparison studies. Stat Methods Med Res 2019;28:2557-2565.

Taffé P, Halfon P, Halfon M. A new statistical methodology to assess bias and precision overcomes the defects of the Bland & Altman method. J Clin Epidemiol 2020;124:1-7.

Taffé P. When can the Bland-Altman limits of agreement method be used and when it should not be used. J Clin Epidemiol 2021; 137:176-181.

Author(s)

Mingkai Peng & Patrick Taffé

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precision_plot *Precision plot*

Description

This plot allows the visual comparison of the precision (i.e. standard deviation) of the new measurement method with that of the reference standard, by creating a scatter plot of the estimated standard deviations against the best linear prediction (BLUP) of the true latent trait x.

Usage

```
precision_plot(object)
```

Arguments

object   an object returned by a call to [measure_compare](#)

Author(s)

Mingkai Peng & Patrick Taffé

Examples

```
### load the data
data(data1)
### analysis
measure_model <- measure_compare(data1)
### Precision plot
precision_plot(measure_model)
```

Index