Package 'rmcorr'

December 13, 2022

Title Repeated Measures Correlation

Version 0.5.4

Description Compute the repeated measures correlation, a statistical technique for determining the overall within-individual relationship among paired measures assessed on two or more occasions, first introduced by Bland and Altman (1995). Includes functions for diagnostics, p-value, effect size with confidence interval including optional bootstrapping, as well as graphing. Also includes several example datasets. For more details, see the web documentation <https://lmarusich.github.io/rmcorr/index.html> and the original paper: Bakdash and Marusich (2017) <doi:10.3389/fpsyg.2017.00456>.

Depends R (>= 4.1.0)

License GPL-2

LazyData true

Imports stats, grDevices, graphics, psych, RColorBrewer

RoxygenNote 7.2.3

Encoding UTF-8

Suggests knitr, rmarkdown, plotrix, ggplot2, lme4, merTools, pwr, AICcmodavg, pals, testthat (>= 3.0.0), vdiffr, corrplot, cocor, covr

VignetteBuilder knitr

Config/testthat/edition 3

URL https://github.com/lmarusich/rmcorr, https://lmarusich.github.io/rmcorr/

BugReports https://github.com/lmarusich/rmcorr/issues

NeedsCompilation no

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Repository CRAN

Date/Publication 2022-12-13 22:40:02 UTC

R topics documented:

`rmcorr-package` *A package for computing the repeated measures correlation coefficient*

Description

Compute the repeated measures correlation, a statistical technique for determining the overall within-individual relationship among paired measures assessed on two or more occasions, first introduced by Bland and Altman (1995). Includes functions for diagnostics, p-value, effect size with confidence interval including optional bootstrapping, as well as graphing. Also includes several example datasets. For more details, see the web documentation <https://lmarusich.github.io/rmcorr/index.html> and the original paper: Bakdash and Marusich (2017) <doi:10.3389/fpsyg.2017.00456>.

References

Bakdash, J.Z. & Marusich, L.R. (2017). Repeated Measures Correlation, *Frontiers in Psychology, 8*, 456, doi:10.3389/fpsyg.2017.00456

Bakdash, J.Z. & Marusich, L.R. (2019). Corrigendum: Repeated Measures Correlation, *Frontiers in Psychology, 10*, doi:10.3389/fpsyg.2019.01201

`bland1995` *Repeated measurements of intramural pH and PaCO2*

Description

A dataset containing the repeated measurements of intramural pH and PaCO2 for eight subjects, from Bland & Altman (1995).

Usage

```
bland1995
```

Format

A data frame with 47 rows and 3 variables

[,1]	Subject	Unique identifer
[,2]	pH	Potential of hydrogen, acidity to base
[,3]	PaCO2	Partial pressure of carbon dioxide

Source

Bland, J.M., & Altman, D.G. (1995). Calculating correlation coefficients with repeated observations: Part 1 – correlation within subjects. *BMJ, 310*, 446, doi:10.1136/bmj.310.6977.446

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gilden2010 *Repeated measurements of reaction time and accuracy*

Description

A dataset containing four repeated measurements of reaction time (RT) and accuracy from eleven subjects in a visual search experiment. Each measurement is the mean RT and accuracy from a block of 288 search trials. blocks of visual search, for eleven subjects.

Usage

```
gilden2010
```

Format

A data frame with 44 rows and 4 variables

[,1]	sub	Subject ID
[,2]	block	Block ID
[,3]	rt	Mean reaction time
[,4]	acc	Mean accuracy

Source

Gilden, D.L., Thornton, T.L., & Marusich, L.R. (2010). The serial process in visual search. *Journal of Experimental Psychology: Human Perception and Performance, 36*, 533-542, doi:10.1037/a0016464

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marusich2016_exp2 *Repeated measurements of dyads performance and subjective situation awareness*

Description

A dataset containing three repeated measures of dyads (paired participants) working together to capture High Value Targets (lower task time is better performance) and their averaged Mission Awareness Rating Scale (MARS) score for each block, repeated three times. MARS evaluates subjective situation awareness ("knowing what is going on"), higher values indicate better situation awareness.

Usage

```
marusich2016_exp2
```

Format

A data frame with 84 rows (28 dyads/pairs) and 4 variables

[,1]	Pair	Unique identifer for each dyad
[,2]	HVT_capture	Capture time
[,3]	MARS	subjective situation awareness
[,4]	Source Reliability	1 = none, 2 = accurate, and 3 = inaccurate

Source

Marusich et al. (2016). Effects of information availability on command-and-control decision making: performance, trust, and situation awareness. *Human Factors, 58*(2), 301-321, doi:10.1177/0018720815619515

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plot.rmc *Plot the repeated measures correlation coefficient.*

Description

`plot.rmc` produces a scatterplot of `measure1` on the x-axis and `measure2` on the y-axis, with a different color used for each subject. Parallel lines are fitted to each subject's data.

Usage

```
## S3 method for class 'rmc'
plot(
  x,
  dataset = NULL,
  overall = F,
  palette = NULL,
  xlab = NULL,
  ylab = NULL,
  overall.col = "gray60",
  overall.lwd = 3,
```

```
  overall.lty = 2,
  ...
)
```

Arguments

x	an object of class "rmc" generated from the rmcorr function.
dataset	Deprecated: This argument is no longer required
overall	logical: if TRUE, plots the regression line between measure1 and measure2, ignoring the participant variable.
palette	the palette to be used. Defaults to the RColorBrewer "Paired" palette
xlab	label for the x axis, defaults to the variable name for measure1.
ylab	label for the y axis, defaults to the variable name for measure2.
overall.col	the color of the overall regression line
overall.lwd	the line thickness of the overall regression line
overall.lty	the line type of the overall regression line
...	additional arguments to plot.

See Also

rmcorr

Examples

```
## Bland Altman 1995 data
my.rmc <- rmcorr(participant = Subject, measure1 = PaCO2, measure2 = pH,
                 dataset = bland1995)
plot(my.rmc)

#using ggplot instead
if (requireNamespace("ggplot2", quietly = TRUE)){
 ggplot2::ggplot(bland1995, ggplot2::aes(x = PaCO2, y = pH,
                 group = factor(Subject), color = factor(Subject))) +
      ggplot2::geom_point(ggplot2::aes(colour = factor(Subject))) +
      ggplot2::geom_line(ggplot2::aes(y = my.rmc$model$fitted.values),
                         linetype = 1)
}


## Raz et al. 2005 data
my.rmc <- rmcorr(participant = Participant, measure1 = Age, measure2 =
                 Volume, dataset = raz2005)
library(RColorBrewer)
blueset <- brewer.pal(8, 'Blues')
pal <- colorRampPalette(blueset)
plot(my.rmc, overall = TRUE, palette = pal, overall.col = 'black')
```

```
## Gilden et al. 2010 data
my.rmc <- rmcorr(participant = sub, measure1 = rt, measure2 = acc,
                 dataset = gilden2010)
plot(my.rmc, overall = FALSE, lty = 2, xlab = "Reaction Time",
     ylab = "Accuracy")
```

`print.rmc` *Print the results of a repeated measures correlation*

Description

Print the results of a repeated measures correlation

Usage

```
## S3 method for class 'rmc'
print(x, ...)
```

Arguments

`x`	An object of class "rmc", a result of a call to rmcorr.
`...`	additional arguments to `print`.

See Also

`rmcorr`

Examples

```
## Bland Altman 1995 data
blandrmc <- rmcorr(Subject, PaCO2, pH, bland1995)
blandrmc
```

`print.rmcmat` *Print the repeated measures correlation matrix*

Description

Print the repeated measures correlation matrix

Usage

```
## S3 method for class 'rmcmat'
print(x, ...)
```

Arguments

x	An object of class "rmcmat", a result of a call to rmcorr_mat.
...	additional arguments to print.

See Also

rmcorr_mat,rmcorr

Examples

```
## Bland Altman 1995 data
blandrmc <- rmcorr(Subject, PaCO2, pH, bland1995)
blandrmc
```

---

raz2005 *Repeated measurements of age and cerebellar volume*

Description

A dataset containing two repeated measures, on two occasions (Time), of age and adjusted volume of cerebellar hemispheres from 72 participants. Data were captured from Figure 8, Cerebellar Hemispheres (lower right) of Raz et al. (2005).

Usage

```
raz2005
```

Format

A data frame with 144 rows and 4 variables

[,1]	Participant	Participant ID
[,2]	Time	Measurement time
[,3]	Age	Participant's age (years)
[,4]	Volume	Adjusted volume of cerebellar hemispheres (cm^3)

Source

Raz, N., Lindenberger, U., Rodrigue, K.M., Kennedy, K.M., Head, D., Williamson, A., Dahle, C., Gerstorf, D., & Acker, J.D. (2005). Regional brain changes in aging healthy adults: General trends, individual differences, and modifiers. *Cerebral Cortex, 15*, 1676-1689, doi:10.1093/cercor/bhi044

---

rmcorr *Calculate the repeated measures correlation coefficient.*

Description

Calculate the repeated measures correlation coefficient.

Usage

```
rmcorr(
  participant,
  measure1,
  measure2,
  dataset,
  CI.level = 0.95,
  CIs = c("analytic", "bootstrap"),
  nreps = 100,
  bstrap.out = F
)
```

Arguments

`participant`	A variable giving the subject name/id for each observation.
`measure1`	A numeric variable giving the observations for one measure.
`measure2`	A numeric variable giving the observations for the second measure.
`dataset`	The data frame containing the variables.
`CI.level`	The confidence level of the interval
`CIs`	The method of calculating confidence intervals.
`nreps`	The number of resamples to take if bootstrapping.
`bstrap.out`	Determines if the output include the bootstrap resamples.

Value

A list with class "rmc" containing the following components.

`r`	the value of the repeated measures correlation coefficient.
`df`	the degrees of freedom
`p`	the p-value for the repeated measures correlation coefficient.
`CI`	the 95% confidence interval for the repeated measures correlation coefficient.
`model`	the multiple regression model used to calculate the correlation coefficient.
`resamples`	the bootstrap resampled correlation values.

References

Bakdash, J.Z., & Marusich, L.R. (2017). Repeated Measures Correlation. *Frontiers in Psychology, 8*, 456, doi:10.3389/fpsyg.2017.00456.

Bakdash, J. Z., & Marusich, L. R. (2019). Corrigendum: Repeated Measures Correlation. *Frontiers in Psychology, 10*, doi:10.3389/fpsyg.2019.01201.

Bland, J.M., & Altman, D.G. (1995a). Calculating correlation coefficients with repeated observations: Part 1 – correlation within subjects. *BMJ, 310*, 446, doi:10.1136/bmj.310.6977.446

Bland, J.M., & Altman, D.G. (1995b). Calculating correlation coefficients with repeated observations: Part 2 – correlation within subjects. *BMJ, 310*, 633, doi:10.1136/bmj.310.6980.633

See Also

plot.rmc

Examples

```
## Bland Altman 1995 data
rmcorr(Subject, PaCO2, pH, bland1995)
```

---

rmcorr_mat *Create a repeated measures correlation matrix.*

Description

Create a repeated measures correlation matrix.

Usage

```
rmcorr_mat(participant, variables, dataset, CI.level = 0.95)
```

Arguments

participant	A variable giving the subject name/id for each observation.
variables	A character vector indicating the columns of variables to include in the correlation matrix.
dataset	The data frame containing the variables.
CI.level	The level of confidence intervals to use in the rmcorr models.

Value

A list with class "rmcmat" containing the following components.

matrix	the repeated measures correlation matrix
summary	a dataframe showing rmcorr stats for each pair of variables
models	a list of the full rmcorr model for each pair of variables

References

Bakdash, J.Z., & Marusich, L.R. (2017). Repeated Measures Correlation. *Frontiers in Psychology, 8*, 456. doi:10.3389/fpsyg.2017.00456.

Bland, J.M., & Altman, D.G. (1995). Calculating correlation coefficients with repeated observations: Part 1 – correlation within subjects. *BMJ, 310*, 446, doi:10.1136/bmj.310.6977.446.

Cohen, P., West, S. G., & Aiken, L. S. (2002). *Applied multiple regression/correlation analysis for the behavioral sciences* (3rd edition), Routledge. ISBN: 9780805822236.

See Also

rmcorr, plot.rmc

Examples

```
dist_rmc_mat <- rmcorr_mat(participant = Subject,
                           variables = c("Blindwalk Away",
                                         "Blindwalk Toward",
                                         "Triangulated BW",
                                         "Verbal",
                                         "Visual matching"),
                           dataset = twedt_dist_measures,
                           CI.level = 0.95)
plot(dist_rmc_mat$models[[2]])
```

---

twedt_dist_measures *Repeated measures and multivariate measures of perceived distance*

Description

A dataset of repeated measures of distance perception at physical distances of 7, 8, 9, 10, and 11 meters. The data are also multivariate, with five dependent measures of distance perception. This is a 5 (physical distance) x 5 (dependent measure) within-participants design with a sample size of 46. Note data is missing for 15 trials due participant and experimenter errors.

Usage

```
twedt_dist_measures
```

Format

A data frame with 230 rows and 7 columns

[,1]	Subject	Unique identifier for each participant
[,2]	Physical Distance	Physical distance from the participant to the target cone, in meters
[,3]	Blindwalk Away	Participants put on the blindfold after viewing the target. Next, participants took one step to th
[,4]	Blindwalk Toward	Participants put on the blindfold after viewing the target. Next, participants walked forward ur
[,5]	Triangulated BW	Participants put on the blindfold after viewing the target. Next, participants turned right 90 deg
[,6]	Verbal	Participants stated the distance between the target cone and themselves, in feet and inches
[,7]	Visual Matching	An experimenter stood next to the target cone and walked away from the cone in a straight lin

Source

Twedt, E. Bakdash, J.Z., and Proffitt, D.R. (2022). Repeated and multivariate measures of perceived distance (Dataset) doi:10.5281/zenodo.6967162

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