Package 'psr'

October 14, 2022

Title Functions for Analyzing Performance Science Data

Date 2021-08-11

Version 0.1.0

Description Contains functions to compute statistics relevant to performance scientists, coaches, and athletes. The functions within the package that report group-wide statistics have to do with measurement instrument reliability and individual change of athletes. Many of them come from the work of Hopkins (2000) <doi:10.2165/00007256-200030010-00001>. There are also functions that apply a particular statistical concept to each measurement in the data.

Encoding UTF-8

License MIT + file LICENSE

Imports dplyr, tidyr, psych, stats

Suggests knitr, rmarkdown, testthat, MASS, boot, Matrix, lme4

Language en-US

VignetteBuilder knitr

RoxygenNote 7.1.0

NeedsCompilation no

Author Thomas McGinn [aut, cre],
Alan Huebner [ctb],
Matthew Sisk [ctb]

Maintainer Thomas McGinn <tmcginn1@nd.edu>

Repository CRAN

Date/Publication 2021-08-13 09:00:02 UTC

R topics documented:

CV *Coefficient of Variation (CV), or typical percentage error (as in Hopkins (2000)), for a set of athlete measurements*

Description

Computes the CV for each vector of measurements that is passed to the function, for the subject and trial vectors

Usage

```
CV(subject, trial, ...)
```

Arguments

`subject`	The vector of athletes who recorded the results for each metric (can be a numeric or factor variable)
`trial`	The vector that represents which trial each measurement came from
`...`	Numeric vectors that represent the metrics for which the CV should be computed. These vectors hold the scores that each athlete recorded for each respective metric (at least one metric must be passed to the function).

Value

A data frame, with the name of each metric situated above its calculated CV

References

Hopkins, W. G. (2000). Measures of Reliability in Sports Medicine and Science. Sports Medicine, 30(5), 375-381.

Examples

```
subject <- c(1, 1, 1, 2, 2, 2, 3, 3, 3)
trial <- c(1, 2, 3, 1, 2, 3, 1, 2, 3)
metric_1 <- c(250, 258, 252, 279, 270, 277, 218, 213, 218)
metric_2 <- c(10, 7, 10, 14, 18, 17, 11, 7, 8)
metric_3 <- c(1214, 1276, 1289, 1037, 1010, 1069, 1481, 1465, 1443)
CV(subject, trial, metric_1, metric_2, metric_3)
```

`ICC_long` *Intra-class Correlation Coefficient (ICC) for a set of athlete measurements, with the data in long format*

Description

Computes the ICC for each vector of measurements that is passed to the function, for the subject and trial vectors

Usage

```
ICC_long(subject, trial, ...)
```

Arguments

`subject`	The vector of athletes who recorded the results for each metric (can be a numeric or factor variable)
`trial`	The vector that represents which trial each measurement came from
`...`	Numeric vectors that represent the metrics for which the ICC output should be given. These vectors hold the scores that each athlete recorded for each respective metric (at least one metric must be passed to the function).

Value

A list, with its contents being the ICC output (containing the six types of ICC's, as generated by psych::ICC()), is returned

References

Shrout, P. E., & Fleiss, J. L. (1979). Intraclass correlations: Uses in assessing rater reliability. Psychological Bulletin, 86(2), 420-428.

Examples

```
subject <- c(1, 1, 1, 2, 2, 2, 3, 3, 3)
trial <- c(1, 2, 3, 1, 2, 3, 1, 2, 3)
metric_1 <- c(250, 258, 252, 279, 270, 277, 218, 213, 218)
metric_2 <- c(10, 7, 10, 14, 18, 17, 11, 7, 8)
metric_3 <- c(1214, 1276, 1289, 1037, 1010, 1069, 1481, 1465, 1443)
ICC_long(subject, trial, metric_1, metric_2, metric_3)
```

MDC *Minimal Detectable Change (MDC) for a set of athlete measurements*

Description

Computes the MDC for each metric that is passed to the function as a vector of athlete measurements, for the subject and trial vectors, the ICC's of each metric, and the desired confidence level

Usage

```
MDC(subject, trial, ..., ICC, confidence = 0.95)
```

Arguments

subject	The vector of athletes who recorded the results for each metric (can be a numeric or factor variable)
trial	The vector that represents which trial each measurement came from
...	Numeric vectors that represent the metrics for which the SEM should be computed. These vectors hold the scores that each athlete recorded for each respective metric (at least one metric must be passed to the function).
ICC	A vector of the ICC's for each of the metrics included in the "..." argument. This vector must contain the same number of elements as the number of metrics that have been passed to the function in the "..." argument, and the reliability values must appear in the same order as the metrics appear in the "..." argument.
confidence	The degree of confidence the user wants to have that an improvement exceeding the MDC can be interpreted as real change, and not the result of measurement error, based on the standard normal distribution. The default value is 0.95.

Value

A data frame, with the name of each metric situated above its calculated MDC

References

Riemann, B. L., & Lininger, M. R. (2018). Statistical Primer for Athletic Trainers: The Essentials of Understanding Measures of Reliability and Minimal Important Change. Journal of Athletic Training, 53(1), 98-103.

Examples

```
subject <- c(1, 1, 1, 2, 2, 2, 3, 3, 3)
trial <- c(1, 2, 3, 1, 2, 3, 1, 2, 3)
metric_1 <- c(250, 258, 252, 279, 270, 277, 218, 213, 218)
metric_2 <- c(10, 7, 10, 14, 18, 17, 11, 7, 8)
metric_3 <- c(1214, 1276, 1289, 1037, 1010, 1069, 1481, 1465, 1443)
MDC(subject, trial, metric_1, metric_2, metric_3, ICC = c(0.92, 0.98, 0.95), confidence = 0.95)
```

psr *psr*

Description

A package for computing various measures relating to reliability of performance science metrics. It contains functions to compute the Typical Error (TE), Coefficient of Variation (CV), Standard Error of Measurement (SEM), Smallest Worthwhile Change (SWC), Minimal Detectable Change (MDC), Intra-class Correlation Coefficient (ICC), and Standard Ten Scores (STEN).

SEM *Standard Error of Measurement (SEM) for a set of athlete measurements*

Description

Computes the SEM for each metric that is passed to the function as a vector of measurements, for the subject and trial vectors and the ICC's of the metrics

Usage

```
SEM(subject, trial, ..., ICC)
```

Arguments

subject	The vector of athletes who recorded the results for each metric (can be a numeric or factor variable)
trial	The vector that represents which trial each measurement came from
...	Numeric vectors that represent the metrics for which the SEM should be computed. These vectors hold the scores that each athlete recorded for each respective metric (at least one metric must be passed to the function).
ICC	A vector of the ICC's for each of the metrics included in the "..." argument. This vector must contain the same number of elements as the number of metrics that have been passed to the function in the "..." argument, and the reliability values must appear in the same order as the metrics appear in the "..." argument.

Value

A data frame, with the name of each metric situated above its calculated SEM

References

Atkinson, G., & Nevill, A. M. (1998). Statistical Methods For Assessing Measurement Error (Reliability) in Variables Relevant to Sports Medicine. Sports Medicine, 26(4), 217-238.

Examples

```
subject <- c(1, 1, 1, 2, 2, 2, 3, 3, 3)
trial <- c(1, 2, 3, 1, 2, 3, 1, 2, 3)
metric_1 <- c(250, 258, 252, 279, 270, 277, 218, 213, 218)
metric_2 <- c(10, 7, 10, 14, 18, 17, 11, 7, 8)
metric_3 <- c(1214, 1276, 1289, 1037, 1010, 1069, 1481, 1465, 1443)
SEM(subject, trial, metric_1, metric_2, metric_3, ICC = c(0.92, 0.98, 0.95))
```

STEN *Standard Ten (STEN) Scores for a set of athlete measurements*

Description

Converts each score of each metric passed to the function into its corresponding STEN score. The STEN score converts metrics that have different units to the same scale, with a minimum value of 1 and a maximum value of 10 for all metrics. This allows one to easily compare an athlete's scores for different metrics that are measured in different units, which enables one to identify which metrics are areas of strength and which are areas of weakness for each athlete. The STEN method fulfills the same purpose as standardizing the scores (i.e. converting all of the scores to z-scores), but might be easier for practitioners and coaches to understand.

Usage

```
STEN(subject, trial, ...)
```

Arguments

`subject`	The vector of athletes who recorded the results for each metric (can be a numeric or factor variable)
`trial`	The vector that represents which trial each measurement came from
`...`	Numeric vectors that represent the metrics which scores should be computed to STEN scores. These vectors hold the scores that each athlete recorded for each respective metric (at least one metric must be passed to the function).

Value

A data frame, with the subjects as rows and the metrics as columns, and each entry representing the original measurement of the given metric having been converted to the unit-less STEN score.

References

Glen, S. (2015). Stephanie Glen. "STEN Score" From StatisticsHowTo.com: Elementary Statistics for the rest of us! https://www.statisticshowto.com/sten-score/

Examples

```
subject <- c(1, 1, 1, 2, 2, 2, 3, 3, 3)
trial <- c(1, 2, 3, 1, 2, 3, 1, 2, 3)
metric_1 <- c(250, 258, 252, 279, 270, 277, 218, 213, 218)
metric_2 <- c(10, 7, 10, 14, 18, 17, 11, 7, 8)
metric_3 <- c(1214, 1276, 1289, 1037, 1010, 1069, 1481, 1465, 1443)
STEN(subject, trial, metric_1, metric_2, metric_3)
```

SWC *Smallest Worthwhile Change (SWC) for a set of athlete measurements*

Description

Computes the SWC for each vector of measurements that is passed to the function, for the subject and trial vectors, the desired effect size of the change, and the desired method of calculating the between-subject standard deviation

Usage

```
SWC(subject, trial, ..., effect_size = 0.2, method = c("AVG", "MAX", "MIN"))
```

Arguments

`subject`	The vector of athletes who recorded the results for each metric (can be a numeric or factor variable)
`trial`	The vector that represents which trial each measurement came from
`...`	Numeric vectors that represent the metrics for which the SWC should be computed. These vectors hold the scores that each athlete recorded for each respective metric (at least one metric must be passed to the function).
`effect_size`	The proportion of the within-subject standard deviation that is defined as a worthwhile change. The default value is 0.2, but users can input any positive value into this argument.
`method`	The user's choice of how the between-athlete SD should be computed in the formula for the SWC. If set to AVG, each athlete's values will be averaged before the SD of these between-athlete averages is computed. If MAX is selected, then only the highest value each athlete records will be included in the computation of the between-athlete SD. Conversely, if the user indicates MIN, then only the lowest value each athlete records will be used to compute the between-athlete SD.

Value

A data frame, with the name of each metric situated above its calculated SWC

References

Bernards, J., Sato, K., Haff, G., & Bazyler, C. (2017). Current Research and Statistical Practices in Sport Science and a Need for Change. Sports, 5(4), 87.

Examples

```
subject <- c(1, 1, 1, 2, 2, 2, 3, 3, 3)
trial <- c(1, 2, 3, 1, 2, 3, 1, 2, 3)
metric_1 <- c(250, 258, 252, 279, 270, 277, 218, 213, 218)
metric_2 <- c(10, 7, 10, 14, 18, 17, 11, 7, 8)
metric_3 <- c(1214, 1276, 1289, 1037, 1010, 1069, 1481, 1465, 1443)
SWC(subject, trial, metric_1, metric_2, metric_3, effect_size = 0.2, method = 'AVG')
```

TE *Typical Error (TE) for a set of athlete measurements*

Description

Computes the TE for each vector of measurements that is passed to the function, for the subject and trial vectors

Usage

```
TE(subject, trial, ...)
```

Arguments

`subject`	The vector of athletes who recorded the results for each metric (can be a numeric or factor variable)
`trial`	The vector that represents which trial each measurement came from
`...`	Numeric vectors that represent the metrics for which the CV should be computed. These vectors hold the scores that each athlete recorded for each respective metric (at least one metric must be passed to the function)

Value

A data frame, with the name of each metric situated above its calculated TE

References

Hopkins, W. G. (2000). Measures of Reliability in Sports Medicine and Science. Sports Medicine, 30(5), 375-381.

Examples

```
subject <- c(1, 1, 1, 2, 2, 2, 3, 3, 3)
trial <- c(1, 2, 3, 1, 2, 3, 1, 2, 3)
metric_1 <- c(250, 258, 252, 279, 270, 277, 218, 213, 218)
metric_2 <- c(10, 7, 10, 14, 18, 17, 11, 7, 8)
metric_3 <- c(1214, 1276, 1289, 1037, 1010, 1069, 1481, 1465, 1443)
TE(subject, trial, metric_1, metric_2, metric_3)
```

Index