Package ‘splithalfr’

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Title  Estimate Split-Half Reliabilities
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Description  Estimates split-half reliabilities for scoring algorithms of cognitive tasks and questionnaires. The 'splithalfr' supports researcher-provided scoring algorithms, with six vignettes illustrating how on included datasets. The package provides four splitting methods (first-second, odd-even, permuted, Monte Carlo), the option to stratify splits by task design, a number of reliability coefficients, and the option to sub-sample data.

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angoff_feldt		Calculate Angoff-Feldt coefficient

Description


Usage

angoff_feldt(x, y)

Arguments

x (vector) a numeric vector
y (vector) a numeric vector with compatible dimensions to x
apply_split_indexes_to_strata

Value

(numeric) Angoff-Feldt coefficient

See Also

Other splithalfr coefficients: assmd(), flanagan_rulon(), sdregi(), short_icc(), spearman_brown()

Examples

# Generate two variables with different means, variances and a correlation of about 0.5
library(MASS)
vars = mvrnorm(30, mu = c(0, 2), Sigma = matrix(c(5, 2, 2, 3), ncol = 2), empirical = TRUE)
# Calculate coefficient
angoff_feldt(vars[,1], vars[,2])

apply_split_indexes_to_strata

Split each element of a list of strata based on a list of indexes

Description

Splits each element of strata into two parts based on a list of indexes. For more information about splitting options, and an extensive list of examples, see get_split_indexes_from_stratum.

Usage

apply_split_indexes_to_strata(strata, indexes)

Arguments

strata (list) list of strata to split
indexes (list) list of indexes, which can be generated via get_split_indexes_from_stratum

Value

(list) A list with two elements, containing the first and second split of strata.

See Also

Other splitting functions: apply_split_indexes_to_stratum(), check_strata(), get_split_indexes_from_stratum()

generate_split_indexes_from_stratum(), split_df(), split_strata(), split_stratum(), stratify()

Examples

# Stratify a data frame, then split it odd-even
ds <- data.frame(condition = rep(c("a", "b"), each = 4), score = 1:8)
strata <- stratify(ds, ds$condition)
split_indexes <- get_split_indexes_from_strata(strata, method = "odd_even")
apply_split_indexes_to_strata(strata, split_indexes)
apply_split_indexes_to_stratum

Split a stratum based on a list of indexes

Description

Splits stratum into two parts based on a list of indexes. For more information about splitting options, and an extensive list of examples, see get_split_indexes_from_stratum.

Usage

apply_split_indexes_to_stratum(stratum, indexes_1, indexes_2)

Arguments

stratum (data frame, tibble, list, or vector) stratum to split
indexes_1 (vector) indexes for first split, which can be generated via get_split_indexes_from_stratum
indexes_2 (vector) indexes for second split, which can be generated via get_split_indexes_from_stratum

Value

(list) List with two elements that contain stratum split in two parts.

See Also

Other splitting functions: apply_split_indexes_to_strata(), check_strata(), get_split_indexes_from_strata(), get_split_indexes_from_stratum(), split_df(), split_strata(), split_stratum(), stratify()

Examples

# Random split-half. One of the splits gets 4 elements and the other 5
stratum = letters[1:9]
indexes = get_split_indexes_from_stratum(stratum)
apply_split_indexes_to_stratum(stratum, indexes[[1]], indexes[[2]])

assmd

Calculate Absolute Strictly Standardized Mean Difference (ASSMD)

Description

Returns the absolute difference of the mean of x and y divided by their shared standard deviation. Since the resulting difference is absolute, the larger of the two means is always used as minuend and the smallest as subtrahend. Based on Zhang (2012) <doi: 10.1016/j.ygeno.2006.12.014>
Usage

assmd(x, y)

Arguments

x (vector) a numeric vector
y (vector) a numeric vector with compatible dimensions to x

Value

(numeric) Absolute SSMD

See Also

Other splithalfr coefficients: angoff_feldt(), flanagan_rulon(), sdregi(), short_icc(), spearman_brown()

Examples

# Generate two variables with different means, variances and a correlation of about 0.5
library(MASS)
vars = mvrnorm(30, mu = c(0, 2), Sigma = matrix(c(5, 2, 2, 3), ncol = 2), empirical = TRUE)
# Calculate Absolute SSMD
assmd(vars[,1], vars[,2])

by_split

Calculate split scores per participant

Description

Calculates split scores, by applying fn_score to subsets of data as specified via participants. It provides a range of additional arguments for different splitting methods and to support parallel processing. To learn more about writing scoring algorithms for use with the splithalfr, see the included vignettes. by_split is modeled after the by function, accepting similar values for the first three arguments (data, INDICES, FUN). For more information about different methods for splitting data, see get_split_indexes_from_stratum. For more information about stratification, see split_df

Usage

by_split(
data,
participants,
fn_score,
stratification = NULL,
replications = 1,
method = c("random", "odd_even", "first_second"),
replace = FALSE,
by_split

split_p = 0.5, 
subsample_p = 1, 
subsample_n = NULL, 
careful = TRUE, 
match_participants = FALSE, 
ncores = detectCores(), 
seed = NULL, 
verbose = TRUE
)

Arguments

(data frame) data frame containing data to score. Data should be in long format, with one row per combination of participant and trial or item.

participants (vector) Vector that identifies participants in data.

fn_score (function) receives full or split sets, should return a single number.

stratification (vector). Vector that identifies which subsets of data should be split separately (denoted as strata in splitting functions) in order to ensure they are evenly distributed between parts. By default, the dataset of a participant forms a single stratum.

replications (numeric) Number of replications that split scores are calculated.

method (character) Splitting method. Note that first_second and odd_even splitting method will only deliver a valid split with default settings for other arguments (split_p = 0.5, replace = FALSE, subsample_p = 1)

replace (logical) If TRUE, stratum is sampled with replacement.

split_p (numeric) Desired length of both parts, expressed as a proportion of the length of the data per participant. If split_p is larger than 1 and careful is FALSE, then parts are automatically sampled with replacement.

subsample_p (numeric) Subsample a proportion of stratum before splitting.

subsample_n (numeric) Subsample a number of participants before splitting.

careful (boolean) If TRUE, stop with an error when called with arguments that may yield unexpected splits.

match_participants (logical) Default FALSE. If FALSE, the split-halves are newly randomized for each iteration and participant. If TRUE, the split-halves are newly randomized for each replication, but within a replication the same randomization is applied across participants. If the order of rows of datasets per participant denotes similar observations (such as items in a questionnaire), match_participants can be set to TRUE to ensure that per iteration, the same items are assigned to each part of the split-halves across participants. If method is “odd_even” or “first_second”, splits are based on row number, so match_participants generally has little effects. If TRUE, each stratum should have the same number of rows, as checked via check_strata.

ncores (integer). By default, all available CPU cores are used. If 1, split replications are executed serially (via lapply). If greater than 1, split replications are executed in parallel, via (via parLapply).
seed (integer). When split replications are executed in parallel, seed can be used to specify a random set to generate random seeds from for each worker via `clusterSetRNGStream`.

verbose (logical) If TRUE, reports progress. Note that progress across split replications is not displayed when these are executed in parallel.

Value

(data frame) Returns a data frame with a column for participant, a column replication that counts split replications, and score_1 and score_2 for the score calculated of each part via fn_score.

Examples

# N.B. This example uses R script from the vignette: "rapi_sum"
data("ds_rapi", package = "splithalfr")
# Convert to long format
ds_long <- reshape(
  ds_rapi,
  varying = paste("V", 1 : 23, sep = ""),
  v.names = "answer",
  direction = "long",
  idvar = "twnr",
  timevar = "item"
)
# Function for RAPI sum score
rapi_fn_score <- function (data) {
  return (sum(data$answer))
}
# Calculate scores on full data
by(
  ds_long,
  ds_long$twnr,
  rapi_fn_score
)
# Permutation split, one iteration, items matched across participants
split_scores <- by_split(
  ds_long,
  ds_long$twnr,
  rapi_fn_score,
  ncores = 1,
  match_participants = TRUE
)
# Mean flanagan-rulon coefficient across splits
fr <- mean(split_coefs(split_scores, flanagan_rulon))

---

check_strata  
*Check whether two strata have the same structure*
Description
Checks \texttt{strata} against \texttt{strata_left}. Each element of \texttt{strata_left} should also be present in \texttt{strata}, be of a similar type (data frame/tibble or list/vector), and be of similar size (\texttt{nrow} for data frames/tibbles or \texttt{length} for lists/vectors). Stops with an error if any checks fail.

Usage
\begin{verbatim}
check_strata(strata_left, strata_right)
\end{verbatim}

Arguments
\begin{verbatim}
strata_left    (list) strata to check against
strata_right   (list) strata to check
\end{verbatim}

Value
None

See Also
Other splitting functions: \texttt{apply_split_indexes_to_strata()}, \texttt{apply_split_indexes_to_stratum()}, \texttt{get_split_indexes_from_strata()}, \texttt{get_split_indexes_from_stratum()}, \texttt{split_df()}, \texttt{split_strata()}, \texttt{split_stratum()}, \texttt{stratify()}

Examples
\begin{verbatim}
check_strata(list(1 : 4), list(1 : 4))
\end{verbatim}

---

\textbf{ds\_aat}

\textit{Example Approach Avoidance Task (AAT) Measurement Data in JASMIN2 Format}

Description
The JASMIN1 AAT was an irrelevant feature task, in which participants were instructed to approach/avoid left/right rotated stimuli. This particular AAT was administered (and described in detail) in doi: 10.1111/add.14071Boffo et al., 2018. Participants were presented stimuli from a "test" category, which were gambling-related pictures, and from a "control" category, which were pictures unrelated to gambling. It registered approach responses by participants pressing (and holding) the arrow down key, while avoid responses were given via the arrow up key. Upon a response, the stimulus zoomed in or out, until it disappeared from the screen. The first response to a stimulus was logged. The dataset contains one row per trial. This dataset was graciously provided by Eva Schmitz.

Usage
\begin{verbatim}
ds\_aat
\end{verbatim}
**ds_gng**

**Format**

An object of class `data.frame` with 6528 rows and 12 columns.

**Details**

Overview of columns:

- **UserID.** Identifies participants
- **approach_tilt.** If "left", participants were instructed to approach left rotated stimuli. If "right", participants were instructed to approach right rotated stimuli.
- **block_type.** Type of block: "practice" for practice trials with neutral stimuli, "assess" for assessment trials with salient stimuli
- **block.** Counts blocks, starting at zero
- **trial.** Counts trials in blocks, starting at zero
- **appr.** If "yes", this trial was an approach trial. If "no", this trial was an avoid trial.
- **tilt.** Whether the stimulus was rotated to the "left" or to the "right"
- **cat.** Stimulus category: "practice", "test", or "control"
- **stim.** Stimulus ID
- **response.** Response; 1 = correct, 2 = incorrect, 3 = timeout (no response in 4000 ms), 4 = invalid key
- **rt.** Response time in milliseconds
- **sust.** Was approach or avoid response sustained until the stimulus was completely zoomed in or out?

---

**Example Go/No Go data**

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**Description**

The Go/No Go is a task in which participants respond to one set of stimuli, but withhold a response to another set of stimuli. This particular dataset is from the first session of a study that is described in detail in doi: 10.1016/j.tate.2019.102887 Hedge, Powell, and Sumner (2018). It was graciously provided by Craig Hedge and can be obtained from https://osf.io/cwzds.

**Usage**

`ds_gng`

**Format**

An object of class `data.frame` with 28200 rows and 7 columns.
Details

Overview of columns:

• block. Block number
• trial. Trial number
• stim. Stimuli set used in that block
• condition. 0 = go, 2 = no go
• response. Correct (1) or incorrect (0)
• rt. Reaction time (seconds)
• participant. Participant ID

Example Implicit Association Task (IAT) Data in JASMIN2 Format

Description

The JASMIN2 IAT closely followed the original IAT procedure (Greenwald, McGhee, & Schwartz, 1998), except that target and attribute trials did not alternate. Upon a correct response, the next trial started. Upon an incorrect response, the current trial was repeated. The response to each trial was logged. This particular dataset is from an Ethnicity-Valence IAT, which was administered (and described in detail) in doi: 10.1016/j.tate.2019.102887 Abacioglu and colleagues (2019). This dataset was graciously provided by Fadie Hanna and Marjolein Zee.

Usage

ds_iat

Format

An object of class data.frame with 9696 rows and 11 columns.

Details

Overview of columns:

• participation_id Identifies participants
• t1_left. If TRUE, the first combination block had target 1 on the left (and target 2 on the right)
• a1_left. If TRUE, the first combination block had attribute 1 on the left (and attribute 2 on the right)
• block_type. Type of block
• block. Counts blocks, starting at zero
• trial. Counts trials in blocks, starting at zero
• attempt. Counts attempts (responses) in trials, starting at zero
ds_rapi

- cat. Category that stimulus belonged to
- stim. Stimulus
- response. Response; 1 = correct, 2 = incorrect, 3 = timeout (no response in 4000 ms), 4 = invalid key
- rt. Response time in milliseconds. Note that some response times may exceed the timeout window due to clock errors on the computer that the IAT was administered

The variable block_type can have these values:
- tar_discr: target discrimination
- att_discr: attribute discrimination
- tar1att1_1: target 1 with attitude 1, practice block
- tar1att1_2: target 1 with attitude 1, test block
- tar_rev: reverse target discrimination
- tar1att2_1: target 1 with attitude 2, practice block
- tar1att2_2: target 1 with attitude 2, test block

ds_rapi Example 23-item Rutgers Alcohol Problem Inventory (RAPI) data

Description

The RAPI is a questionnaire which asks how often a participant experienced each of 23 alcohol-related problems within the last year (doi: 10.15288/jsa.1989.50.30White & Labouvie, 1989). The dataset contains one row per participant.

Usage
ds_rapi

Format

An object of class data.frame with 426 rows and 24 columns.

Details

The dataset contains the following columns:
- twnr. Identifies participants
- V1 to V23. Answers on each of the 23 RAPI items

Each item is answered on a four-point scale with the following answer options:
- 0 = None
- 1 = 1-2 times
- 2 = 3-5
- 3 = More than 5 times
Example Stop Signal Task data

**Description**

The Stop Signal Task is a task in which participants responded whether a stimulus was a square or a circle. On 25 This particular dataset is from the first session of a study that is described in detail in doi: 10.1016/j.tate.2019.102887 Hedge, Powell, and Sumner (2018). It was graciously provided by Craig Hedge and can be obtained from https://osf.io/cwzds.

**Usage**

ds_sst

**Format**

An object of class `data.frame` with 27000 rows and 7 columns.

**Details**

Overview of columns:

- block. Block number
- trial. Trial number
- ssd. Stop signal delay
- condition. 0 = go, 1 = stop
- response. Correct (1) or incorrect (0)
- rt. Reaction time (milliseconds)
- participant. Participant ID

Example Visual Probe Task (VPT) Measurement Data in JASMIN1 Format

**Description**

The JASMIN1 VPT distinguished between "test" stimuli, which are in some way assumed to be salient to the participant and "control" stimuli, which are not. Test and control stimuli were presented in pairs, with one left and one right, followed by a probe that was an arrow pointing up or down. Participants needed to indicate whether the arrow pointed up or down. Upon a correct response the next trial started and upon an incorrect response the current trial was repeated. Only the first response to a new trial was logged. This particular VPT was part of the pre-measurement of a cognitive bias modification study. The "test" stimuli were alcoholic beverages and the "control" stimuli were non-alcoholic beverages, selected from the Amsterdam Beverage Picture Set doi: 10.1111/acer.12853 (Pronk, Deursen, Beraha, Larsen, & Wiers, 2015). The dataset contains one row per trial. This dataset was graciously provided by Marilisa Boffo.
Usage

\texttt{ds_vpt}

Format

An object of class \texttt{data.frame} with 19520 rows and 12 columns.

Details

Overview of columns:

- UserID. Identifies participants
- patt. Probe-at-test. If "yes", the probe was positioned at the test stimulus. If "no", the probe was positioned at the control stimulus.
- phor. Probe horizontal position. Values: "left" or "right"
- thor. Test horizontal position. Values: "left" or "right"
- keep. If "yes" the probe was superimposed on the stimuli. If "no" the probe replaced the stimuli.
- pdir. Probe direction. Values: "up" or "down"
- stim. Stimulus
- response. Response; 1 = correct, 2 = incorrect, 3 and NA = timeout (no response in 5000 ms), 4 = invalid key
- rt. Response time in milliseconds
- block. Counts blocks, starting at zero
- trial. Counts trials in blocks, starting at zero
- block_type. Type of block: "assess" for assessment trials with salient stimuli

\begin{itemize}
  \item \textbf{flanagan_rulon} \hfill \textit{Calculate Flanagon-Rulon coefficient}
\end{itemize}

Description


Usage

\texttt{flanagan_rulon(x, y)}

Arguments

\begin{itemize}
  \item \texttt{x} \hfill (vector) a numeric vector
  \item \texttt{y} \hfill (vector) a numeric vector with compatible dimensions to \texttt{x}
\end{itemize}
Value

(numeric) Flanagan-Rulon coefficient

See Also

Other splitahlf coefficients: angoff_feldt(), assmd(), sdregi(), short_icc(), spearman_brown()

Examples

# Generate two variables with different means, variances and a correlation of about 0.5
library(MASS)
vars = mvrnorm(30, mu = c(0, 2), Sigma = matrix(c(5, 2, 2, 3), ncol = 2), empirical = TRUE)
# Calculate coefficient
flanagan_rulon(vars[,1], vars[,2])

get_split_indexes_from_strata

Generate indexes for splitting strata

Description

Generates indexes for splitting each element of strata into two parts. For more information about splitting options, and an extensive list of examples, see get_split_indexes_from_stratum.

Usage

generate_split_indexes_from_strata(strata, ...)

Arguments

strata (list) Strata to split...

Arguments passed on to get_split_indexes_from_stratum

method (character) Splitting method. Note that first_second and odd_even splitting method will only deliver a valid split with default settings for other arguments (subsample_p = 1, split_p = 1, replace = TRUE)
replace (logical) If FALSE, splits are constructed by sampling from stratum without replacement. If TRUE, stratum is sampled with replacement.

split_p (numeric) Desired joint size of both parts, expressed as a proportion of the size of the subsampled stratum. If split_p is larger than 1, and careful is FALSE, then parts are automatically sampled with replacement.
subsample_p (numeric) Subsample a proportion of stratum to be used in the split.

Careful (boolean) If TRUE, stop with an error when called with arguments that may yield unexpected splits
get_split_indexes_from_stratum

Value

(list) A list with two elements, containing the first and second part of strata.

See Also

Other splitting functions: apply_split_indexes_to_strata(), apply_split_indexes_to_stratum(), check_strata(), get_split_indexes_from_strata(), split_df(), split_strata(), split_stratum(), stratify()

Examples

# Stratify a data frame, then split it odd-even
ds <- data.frame(condition = rep(c("a", "b"), each = 4), score = 1:8)
strata <- stratify(ds, ds$condition)
split_indexes <- get_split_indexes_from_strata(strata, method = "odd_even")
apply_split_indexes_to_strata(strata, split_indexes)

get_split_indexes_from_stratum

Generate indexes that can be used to split a stratum into two parts

Description

get_split_indexes_from_stratum returns a list with indexes for splitting its stratum argument in two parts. The splits differ at most by one in size. With default arguments, a random split-half is returned, which samples elements for each part from stratum without replacement. Via additional arguments to get_split_indexes_from_stratum a range of other splitting methods can be applied.

Usage

get_split_indexes_from_stratum(
  stratum,
  method = c("random", "odd_even", "first_second"),
  replace = FALSE,
  split_p = 0.5,
  subsample_p = 1,
  careful = TRUE
)

Arguments

stratum (data frame, tibble, list, or vector) Object to split; dataframes and tibbles are counted and split by row. All other data types are counted and split by element

method (character) Splitting method. Note that first_second and odd_even splitting method will only deliver a valid split with default settings for other arguments (subsample_p = 1, split_p = 1, replace = TRUE)
get_split_indexes_from_stratum

- **replace** (logical) If FALSE, splits are constructed by sampling from stratum without replacement. If TRUE, stratum is sampled with replacement.
- **split_p** (numeric) Desired joint size of both parts, expressed as a proportion of the size of the subsampled stratum. If split_p is larger than 1, and careful is FALSE, then parts are automatically sampled with replacement.
- **subsample_p** (numeric) Subsample a proportion of stratum to be used in the split.
- **careful** (boolean) If TRUE, stop with an error when called with arguments that may yield unexpected splits.

**Details**

The following rounding rules apply to subsample size and split size:

- If the size of the subsample, calculated as subsample_p times size of stratum, is a fraction, then subsample size is rounded up.
- If the joint size of the two parts, calculated as 2 * split_p times size of the subsampled stratum, is a fraction, the part size is rounded up.
- If the joint size of the two parts is odd and replace is FALSE, then one of the parts randomly gets one more element than the other part.
- If the joint size of the two parts is odd and replace is TRUE, part size is rounded up to the next whole number, so each of the splits has the same size.

**Value**

(list) List with two elements that contain indexes that can be used to split the stratum in two parts two splits of stratum.

**See Also**

Other splitting functions: apply_split_indexes_to_strata(), apply_split_indexes_to_stratum(), check_strata(), get_split_indexes_from_strata(), split_df(), split_strata(), split_stratum(), stratify()

**Examples**

```
# Split-half. One of the splits gets 4 elements and the other 5
stratum = letters[1:9]
indexes = get_split_indexes_from_stratum(stratum)
apply_split_indexes_to_stratum(stratum, indexes[[1]], indexes[[2]])
```
### sdregi

**SD ratio of equalities or greater inequalities**

**Description**

Returns the ratio of the SDs of x and y, using the largest SD of the two as denominator. Hence, the result is always 1 (ratio of equalities) or greater than 1 (ratio of greater inequalities). If x or y have less than two elements, NA is returned.

**Usage**

sdregi(x, y)

**Arguments**

- x  
  (vector) a numeric vector
- y  
  (vector) a numeric vector with compatible dimensions to x

**Value**

(numeric) SD ratio

**See Also**

Other splithalfr coefficients: angoff_feldt(), assmd(), flanagan_rulon(), short_icc(), spearman_brown()

**Examples**

# Generate two variables with different means, variances and a correlation of about 0.5
library(MASS)
vars = mvrnorm(30, mu = c(0, 2), Sigma = matrix(c(5, 2, 2, 3), ncol = 2), empirical = TRUE)
# Calculate SD ratio of left and right variables
sdregi(vars[,1], vars[,2])
# Calculate SD ratio of right and left variables; should give same result
sdregi(vars[,2], vars[,1])

---

### short_icc

**Calculate Intraclass Correlation Coefficient (ICC)**

**Description**

Wrapper for ICCs calculated via ICC. If x or y have less than two elements, NA is returned.
Usage

short_icc(
  x,
  y,
  type = c("ICC1", "ICC2", "ICC3", "ICC1k", "ICC2k", "ICC3k"),
  ...
)

Arguments

x (vector) a numeric vector
y (vector) a numeric vector with compatible dimensions to x
type (character) type of ICC to calculate, see ICC
... Arguments passed to ICC

Value

(numeric) Value of ICC coefficient

See Also

Other splithalf coefficients: angoff_feldt(), assmd(), flanagan_rulon(), sdregi(), spearman_brown()

Examples

# Generate two variables with different means, variances and a correlation of about 0.5
library(MASS)
vars = mvrnorm(30, mu = c(0, 2), Sigma = matrix(c(5, 2, 2, 3), ncol = 2), empirical = TRUE)
# Calculate ICC1
short_icc(vars[,1], vars[,2], type = "ICC1", lmer = FALSE)

spearman_brown

Calculate Spearman-brown coefficient

Description


Usage

spearman_brown(x, y, fn_cor = cor, ...)
Arguments

x (vector) a numeric vector
y (vector) a numeric vector with compatible dimensions to x
fn_cor (function) a function returning a correlation coefficient
... Arguments passed to fn_cor

Value

(numeric) Spearman-Brown coefficient

See Also

Other splithalfr coefficients: \texttt{angoff\_feldt()}, \texttt{assmd()}, \texttt{flanagan\_rulon()}, \texttt{sdregi()}, \texttt{short\_icc()}

Examples

# Generate two variables with different means, variances and a correlation of about 0.5
library(MASS)
vars = mvrnorm(30, mu = c(0, 2), Sigma = matrix(c(5, 2, 2, 3), ncol = 2), empirical = TRUE)
# Calculate coefficient based on Pearson correlation
spearman_brown(vars[,1], vars[,2])
# Calculate coefficient based on ICC, two-way, random effects, absolute agreement, single rater
spearman_brown(vars[,1], vars[,2], short_icc, type = "ICC1", lmer = FALSE)
Splitting methods

The splithalfr supports a variety of methods for splitting your data. We review and assess each method in the compendium paper (Pronk et al., 2021 <doi: 10.3758/s13423021019483>). This vignette illustrates how to apply each splitting method via the splithalfr: vignette("splitting_methods")

- stratified (Green et al., 2016 <doi: 10.3758/s1342301509683>)
- Monte Carlo (Williams & Kaufmann, 2012 <doi: 10.1016/j.jesp.2012.03.001>)

Validation of split-half estimations

Part of the splithalfr algorithm has been validated via a set of simulations that are not included in this package. The R script for these simulations can be found here.

Related packages

These R packages offer bootstrapped split-half reliabilities for specific scoring algorithms and are available via CRAN at the time of this writing: multicon, psych, and splithalf.

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---

**split_ci**

*Calculate nonparametric bias-corrected and accelerated bootstrap confidence intervals for coefficients averaged across split replications*
split_ci

Description

Calculates nonparametric bias-corrected and accelerated bootstrap confidence intervals via `bcajack`. Coefficients are `ds` should be a data frame as returned by `by_split`: Each unique value of the column `participant` is considered a independent sample of the target population. For each unique value of the column `split` in `ds`, it selects the corresponding rows in `ds`, and passes the values in the columns `score_1` and `score_2` as the first and second argument to `fn_coef`. Any row in `ds` for which `score_1` or `score_2` is NA is pairwise removed before passing the data to `fn_coef`. Any coefficient that is NA is removed before passing the data to `fn_summary`.

Usage

```r
split_ci(
  ds,
  fn_coef,
  fn_average = function(values) { mean(values, na.rm = TRUE) },
  replications = 1000,
  ...
)
```

Arguments

- `ds` (data frame) a data frame with columns `split`, `score_1`, and `score_2`
- `fn_coef` (function) a function that calculates a bivariate coefficient.
- `fn_average` (function) a function that calculates an average across coefficients
- `replications` (integer) number of bootstrap replications
- `...` Additional arguments passed to `bcajack`

Details

For averaging internal consistency coefficients, see Feldt and Charter (2006). For more information about bias-corrected and accelerated bootstrap confidence intervals, see Efron (1987).

Value

Confidence interval

References


See Also

Other split aggregation functions: `split_coefs()`
Examples

```r
# Generate five splits with scores that are correlated 0.00, 0.25, 0.5, 0.75, and 1.00
library(MASS)
ds_splits = data.frame(V1 = numeric(), V2 = numeric(), split = numeric())
for (r in 0:4) {
  vars = mvrnorm(10, mu = c(0, 0), Sigma = matrix(c(10, 3, 3, 2), ncol = 2), empirical = FALSE)
ds_splits = rbind(ds_splits, cbind(vars, r, 1 : 10))
}
names(ds_splits) = c("score_1", "score_2", "replication", "participant")
# Calculate confidence interval
split_ci(ds_splits, cor)
```

---

**split_coefs**

*Calculate a bivariate coefficient for each split-half replication*

**Description**

Calculates a bivariate coefficient across participants for each split-half replication and returns their values calculated across replications. `ds` should be a data frame as returned by `by_split`: For each unique value of the column `split` in `ds`, it selects the corresponding rows in `ds`, and passes the values in the columns `score_1` and `score_2` as the first and second argument to `fn_coef`. Any row in `ds` for which `score_1` or `score_2` is NA is pairwise removed before passing the data to `fn_coef`. For averaging internal consistency coefficients, see Feldt and Charter (2006).

**Usage**

```r
split_coefs(ds, fn_coef, ...)
```

**Arguments**

- `ds` *(data frame)* a data frame with columns `split`, `score_1`, and `score_2`
- `fn_coef` *(function)* a function that calculates a bivariate coefficient.
- `...` Additional arguments passed to `fn_coef`

**Value**

Coefficients per split calculated via `fn_coef`.

**References**


**See Also**

Other split aggregation functions: `split_ci()`
Examples

# Generate five splits with scores that are correlated 0.00, 0.25, 0.5, 0.75, and 1.00
library(MASS)
ds_splits = data.frame(score_1 = numeric(), score_2 = numeric(), replication = numeric())
for (r in 0:4) {
  vars = mvrnorm(10, mu = c(0, 0), Sigma = matrix(c(10, 3, 3, 2), ncol = 2), empirical = FALSE)
ds_splits = rbind(ds_splits, cbind(vars, r))
}
names(ds_splits) = c("score_1", "score_2", "replication")
# Pearson correlations
split_coefs(ds_splits, cor)
# Spearman-brown corrected Pearson correlations
split_coefs(ds_splits, spearman_brown)
# Flanagan-Rulon coefficient
split_coefs(ds_splits, flanagan_rulon)
# Angoff-Feldt coefficient
split_coefs(ds_splits, angoff_feldt)
# Spearman-Brown corrected ICCs
split_coefs(
  ds_splits,
  spearman_brown,
  short_icc,
  type = "ICC1",
  lmer = FALSE
)

split_df

Split a data frame into two parts

Description

Splits data. Applies a stratified split to a data frame and returns each part. For more information about splitting options, and an extensive list of examples, see get_split_indexes_from_stratum.

Usage

split_df(data, stratification = NULL, ...)

Arguments

data (data frame) Data to split, in long format, with one row per observation.
stratification (vector). Vector that identifies which subsets of data should be split separately (denoted as strata in splitting functions) in order to ensure they are evenly distributed between parts. If NULL, all data is considered a single stratum.

... Arguments passed on to get_split_indexes_from_stratum

method (character) Splitting method. Note that first_second and odd_even splitting method will only deliver a valid split with default settings for other arguments (subsample_p = 1, split_p = 1, replace = TRUE)
replace (logical) If FALSE, splits are constructed by sampling from stratum without replacement. If TRUE, stratum is sampled with replacement.

split_p (numeric) Desired joint size of both parts, expressed as a proportion of the size of the subsampled stratum. If split_p is larger than 1 and careful is FALSE, then parts are automatically sampled with replacement.

subsample_p (numeric) Subsample a proportion of stratum to be used in the split.

careful (boolean) If TRUE, stop with an error when called with arguments that may yield unexpected splits.

Value

(list) List with two elements that each contain one of two parts.

See Also

Other splitting functions: apply_split_indexes_to_strata(), apply_split_indexes_to_stratum(), check_strata(), get_split_indexes_from_strata(), get_split_indexes_from_stratum(), split_strata(), split_stratum(), stratify()

Examples

ds <- data.frame(condition = rep(c("a", "b"), each = 4), score = 1 : 8)
split_df(ds, method = "random")
split_df(ds, method = "odd_even")
split_df(ds, method = "first_second")
split_df(ds, stratification = ds$condition, method = "random")
split_df(ds, stratification = ds$condition, method = "odd_even")
split_df(ds, stratification = ds$condition, method = "first_second")
ds <- data.frame(condition = rep(c("a", "b"), 4), score = 1 : 8)
split_df(ds, method = "random")
split_df(ds, method = "odd_even")
split_df(ds, method = "first_second")
split_df(ds, stratification = ds$condition, method = "random")
split_df(ds, stratification = ds$condition, method = "odd_even")
split_df(ds, stratification = ds$condition, method = "first_second")

split_strata

Split each stratum into two parts

Description

Splits each element of strata into two parts. For more information about splitting options, and an extensive list of examples, see get_split_indexes_from_stratum.

Usage

split_strata(strata, ...)

split_stratum

Arguments

strata  (list) list of strata to split

...  Arguments passed on to get_split_indexes_from_stratum

method (character) Splitting method. Note that first_second and odd_even splitting method will only deliver a valid split with default settings for other arguments (subsample_p = 1, split_p = 1, replace = TRUE)

replace (logical) If FALSE, splits are constructed by sampling from stratum without replacement. If TRUE, stratum is sampled with replacement.

split_p (numeric) Desired joint size of both parts, expressed as a proportion of the size of the subsampled stratum. If split_p is larger than 1, and careful is FALSE, then parts are automatically sampled with replacement

subsample_p (numeric) Subsample a proportion of stratum to be used in the split.

careful (boolean) If TRUE, stop with an error when called with arguments that may yield unexpected splits

Value

(list) A list with two elements, containing the first and second split of strata.

See Also

Other splitting functions: apply_split_indexes_to_strata(), apply_split_indexes_to_stratum(), check_strata(), get_split_indexes_from_strata(), get_split_indexes_from_stratum(), split_df(), split_stratum(), stratify()

Examples

# Stratify a data frame, then split it odd-even
ds <- data.frame(condition = rep(c("a", "b"), each = 4), score = 1:8)
strata <- stratify(ds, ds$condition)
split_strata(strata, method = "odd_even")

split_stratum

Split a stratum into two parts

Description

Splits stratum into two parts. For more information about splitting options, and an extensive list of examples, see get_split_indexes_from_stratum.

Usage

split_stratum(stratum, ...)


Arguments

- **stratum** (data frame, tibble, list, or vector) Stratum to split; dataframes and tibbles are counted and split by row. All other data types are counted and split by element

- **method** (character) Splitting method. Note that first_second and odd_even splitting method will only deliver a valid split with default settings for other arguments (subsample_p = 1, split_p = 1, replace = TRUE)

- **replace** (logical) If FALSE, splits are constructed by sampling from stratum without replacement. If TRUE, stratum is sampled with replacement.

- **split_p** (numeric) Desired joint size of both parts, expressed as a proportion of the size of the subsampled stratum. If split_p is larger than 1, and careful is FALSE, then parts are automatically sampled with replacement

- **subsample_p** (numeric) Subsample a proportion of stratum to be used in the split.

- **careful** (boolean) If TRUE, stop with an error when called with arguments that may yield unexpected splits

Value

(list) List with two elements that contain each of the two parts of stratum split in two.

See Also

Other splitting functions: apply_split_indexes_to_strata(), apply_split_indexes_to_stratum(), check_strata(), get_split_indexes_from_strata(), get_split_indexes_from_stratum(), split_df(), split_strata(), stratify()

Examples

```r
# Split stratum odd-even
ds <- data.frame(condition = rep(c("a", "b"), each = 4), score = 1 : 8)
split_stratum(ds, method = "odd_even")
```

---

**stratify**  
Stratify a data frame

Description

Split a dataframe into strata formed by each a unique value of stratification.

Usage

```r
stratify(ds, stratification = NULL)
```
Arguments

- **ds** (data frame) data to split into strata
- **stratification** (vector). Vector that identifies which subsets of data should be split separately (denoted as strata in splitting functions) in order to ensure they are evenly distributed between parts. If NULL, all data is considered a single stratum.

Value

(list) List of strata

See Also

Other splitting functions: `apply_split_indexes_to_strata()`, `apply_split_indexes_to_stratum()`, `check_strata()`, `get_split_indexes_from_strata()`, `get_split_indexes_from_stratum()`, `split_df()`, `split_strata()`, `split_stratum()`

Examples

```r
# Stratify a data frame, then split it odd-even
ds <- data.frame(condition = rep(c("a", "b"), each = 4), score = 1:8)
strata <- stratify(ds, ds$condition)
split_strata(strata, method = "odd_even")
```
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