Package 'SingleCaseES'

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Type Package

Title A Calculator for Single-Case Effect Sizes

Version 0.7.3

Description Provides R functions for calculating basic effect size indices for
single-case designs, including several non-overlap measures and parametric
effect size measures, and for estimating the gradual effects model developed
by Swan and Pustejovsky (2018) <DOI:10.1080/00273171.2018.1466681>.
Standard errors and confidence intervals (based on the assumption that the outcome
measurements are mutually independent) are provided for the subset of effect sizes
indices with known sampling distributions.

URL https://jepusto.github.io/SingleCaseES/

BugReports https://github.com/jepusto/SingleCaseES/issues

License GPL-3

Imports stats, purrr, dplyr, tidyr, rlang, tidyselect, utils

Suggests spelling, shiny, stringr, rvest, xml2, ggplot2, purrrlyr,
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Contents

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batch_calc_ES   *Calculate effect sizes from a dataset for multiple series*

Description

Calculates one or more effect size estimates, along with associated standard errors and confidence intervals, if available, for a single-case data series.

Usage

```
batch_calc_ES(
  dat,
  grouping,
  condition,
  outcome,
  aggregate = NULL,
  weighting = "equal",
  session_number = NULL,
  baseline_phase = NULL,
  intervention_phase = NULL,
  ES = c("LRRd", "LRRi", "SMD", "Tau"),
  improvement = "increase",
  scale = "other",
  intervals = NA,
  observation_length = NA,
  goal = NULL,
  confidence = 0.95,
  format = "long",
  warn = TRUE,
  ...
)
```

Arguments

dat	data frame containing SCD series for which effect sizes will be calculated.
grouping	A variable name or list of (unquoted) variable names that uniquely identify each data series.
condition	A variable name that identifies the treatment condition for each observation in the series.
outcome	A variable name for the outcome data. Default is
aggregate	A variable name of list of (unquoted) variable names that identify additional grouping variables. Effect sizes will be calculated separately for each unique value of these variables, after which the effect size estimates will be averaged across values of these variables (but not across the values of the grouping variables).

weighting	character string specifying the weighting scheme for use when variables are specified in `aggregate`. Available is `"1/V"`, `"equal"` (the default), `"Equal"`, `"nA"`, `"n_A"`, `"nB"`, `"n_B"`, `"nAnB"`, `"nA*nB"`, `"nA*nB"`, `"n_A*n_B"`, `"n_A *` `n_B"`, `"1/nA+1/nB"`, `"1/nA + 1/nB"`, `"1/n_A+1/n_B"`, or `"1/n_A + 1/n_B"`. Note that `"1/V"` can only be used for effect sizes with known standard errors.
session_number	A variable name used to order the data within each series.
baseline_phase	character string specifying which value of `condition` corresponds to the baseline phase. If `NULL` (the default), the first observed value of `condition` within the series will be used.
intervention_phase	
	character string specifying which value of `condition` corresponds to the intervention phase. If `NULL` (the default), the second unique value of `condition` within the series will be used.
ES	character string or character vector specifying which effect size index or indices to calculate. Available effect sizes are `"LRRd"`, `"LRRi"`, `"LRM"`, `"LOR"`, `"SMD"`, `"NAP"`, `"IRD"`, `"PND"`, `"PEM"`, `"PAND"`, `"PoGO"`, `"Tau"`, `"Tau-U"`, and `"Tau-BC"`. Set to `"all"` for all available effect sizes. Set to `"parametric"` for all parametric effect sizes. Set to `"NOM"` for all non-overlap measures. Defaults to calculating the LRRd, LRRi, SMD, and Tau indices.
improvement	character string either indicating the direction of uniform improvement ("increase" or "decrease") or the variable name of a variable identifying the direction of improvement for each series. Default is "increase".
scale	character string indicating the common scale of the outcome variable across all of the series in the data set or the name of a variable within the dataset that identifies the outcome scale within each series. Possible values for the scale are `"percentage"` for a percentage with range 0-100, `"proportion"` for a proportion with range 0-1, `"count"` for a frequency count (0 or positive integers), `"rate"` for a standardized rate per minute. If a vector, the most frequent unique value will be used and missing values will be ignored. Defaults to NA.
intervals	for interval recording procedures. Either the total number of intervals per observation session common to all series in the dataset, or the name of a variable within the dataset that identifies the number of intervals for each observation. If a variable name, the mean number of intervals within each series will be used. Missing values will be ignored. Defaults to NA.
observation_length	
	Used for the log-response ratio. Either the common observation session length (in minutes) across all series in the dataset or a variable name containing the observation session length for each observation. If a variable name, the mean observation session length within each series will be used. Missing values will be ignored. Defaults to NA.
goal	Used for the percent of goal obtained. Either a numeric common goal level across all series in the dataset or a variable name containing the goal level for each series. If a variable name, the mean goal level within each series will be used. Missing values will be ignored. Defaults to NULL.
confidence	confidence level for the reported interval estimate. Set to `NULL` to omit confidence interval calculations.

format	character string specifying whether to organize the results in `"long"` format or `"wide"` format. Defaults to `"long"`.
warn	logical indicating whether warnings should be displayed. Default is `TRUE`.
...	further arguments used for calculating some of the effect size indices.

Details

Calculates one or more effect size indices for each series in a dataset

Value

A tibble containing the estimate, standard error, and/or confidence interval for each specified effect size.

Examples

```
data(McKissick)
batch_calc_ES(McKissick,
              grouping = Case_pseudonym,
              condition = Condition,
              outcome = Outcome,
              ES = c("LRRd","LRRi"),
              improvement = "decrease",
              scale = "count",
              observation_length = 20,
              format = "long")

data(Schmidt2007)
batch_calc_ES(dat = Schmidt2007,
              grouping = c(Behavior_type, Case_pseudonym, Phase_num),
              condition = Condition,
              outcome = Outcome,
              ES = c("LRRi","LRRd"),
              improvement = direction,
              scale = Metric,
              bias_correct = TRUE,
              confidence = NULL,
              format = "wide")

# Aggregate across phase-pairs
batch_calc_ES(dat = Schmidt2007,
          grouping = c(Behavior_type, Case_pseudonym),
          aggregate = Phase_num,
          weighting = "1/V",
          condition = Condition,
          outcome = Outcome,
          ES = c("LRRi", "LRRd", "SMD", "Tau"),
          improvement = direction,
          scale = "count",
          bias_correct = TRUE,
          confidence = NULL,
          format = "long")
```

Byiers2014	*Byiers et al., (2014)*

Description

Data from an ABAB design that evaluated the effectiveness of functional assessment and functional communication training on the Rett syndrome (RTT) of three individuals with RTT novel communicative behaviors. The dependent variable, communicative behavior, was measured using frequency counting for a five minute observation session. A single outcome (percent of switch activated responses) was calculated with appropriate responses per minute divided by inappropriate responses per minute, multiplied by 100. The variables are as follows:

- StudyID. Study identifier.

- StudyID_CaseID. Participant identifier.

- Session_number. Within-series session-number.

- Condition. Indicates condition, (A for baseline, B for treatment).

- Outcome. Value for the percent of switch activated responses.

- Session_length. Length of the session.

- Procedure. Scale of the outcome variable.

- Goal_level. Indicates the goal level for each series.

- phase_pair_calculated. Indicates the unique phase number of each sequential occurrence of a phase for each participant of ABAB design.

Format

A data frame with 54 rows and 9 variables

Source

Byiers, B. J., Dimian, A., & Symons, F. J. (2014). Functional communication training in Rett syndrome: A preliminary study. *American Journal on Intellectual and Developmental Disabilities, 119*(4), 340-350. doi:10.1352/1944-7558-119.4.340

---

calc_ES   *Calculate effect sizes*

Description

Calculates one or more effect size estimates, along with associated standard errors and confidence intervals, if available, for a single-case data series.

Usage

```
calc_ES(
  A_data,
  B_data,
  condition,
  outcome,
  baseline_phase = NULL,
  intervention_phase = NULL,
  ES = c("LRRd", "LRRi", "SMD", "Tau"),
  improvement = "increase",
  ...,
  confidence = 0.95,
  format = "long"
)
```

Arguments

A_data	vector of numeric data for A phase. Missing values are dropped.
B_data	vector of numeric data for B phase. Missing values are dropped.
condition	vector identifying the treatment condition for each observation in the series.
outcome	vector of outcome data for the entire series.
baseline_phase	character string specifying which value of condition corresponds to the baseline phase. Defaults to first observed value of condition.
intervention_phase	
	character string specifying which value of condition corresponds to the intervention phase. Defaults to second unique value of condition.
ES	character string or character vector specifying which effect size index or indices to calculate. Available effect sizes are "LRRd", "LRRi", "LRM", "LOR", "SMD", "NAP", "IRD", "PND", "PEM", "PAND", "PoGO", "Tau", "Tau-U", and "Tau-BC". Set to "all" for all available effect sizes. Set to "parametric" for all parametric effect sizes. Set to "NOM" for all non-overlap measures. Defaults to calculating the LRRd, LRRi, SMD, and Tau indices.
improvement	character string indicating direction of improvement. Default is "increase".
...	further arguments used for calculating some of the effect size indices.
confidence	confidence level for the reported interval estimate. Set to NULL to omit confidence interval calculations.

format   character string specifying whether to organize the results in "long" format or
                          "wide" format. Defaults to "long".

Details

Calculates one or more effect size indices

Value

A data.frame containing the estimate, standard error, and/or confidence interval for each specified
effect size.

Examples

```
# Using the A_data and B_data arguments
A <- c(20, 20, 26, 25, 22, 23)
B <- c(28, 25, 24, 27, 30, 30, 29)
calc_ES(A_data = A, B_data = B)

# Using the condition and outcome arguments
phase <- c(rep("A", length(A)), rep("B", length(B)))
outcome <- c(A, B)
calc_ES(condition = phase, outcome = outcome, baseline_phase = "A")

# Example from Parker & Vannest (2009)
yA <- c(4, 3, 4, 3, 4, 7, 5, 2, 3, 2)
yB <- c(5, 9, 7, 9, 7, 5, 9, 11, 11, 10, 9)
calc_ES(yA, yB)
```

---

calc_phase_pairs   *Calculate phase pair numbers*

Description

Calculates a vector containing a unique phase number for every sequential occurrence of a phase or
treatment condition. This is useful for creating a grouping variable to be used in calculating effect
sizes for each pair of A-B phases within treatment reversal designs.

Usage

```
calc_phase_pairs(x, session = seq_along(x))
```

Arguments

x   vector of phase/condition labels.

session   numeric vector of measurement occasions, used to sort x before calculating
                          phase pairs.

Value

A vector containing an integer phase number for every observation.

Examples

```
# Basic use-case
x <- rep(c("A","B","C","B","C","A","C"), c(4:10))
calc_phase_pairs(x)

# Using session argument to handle sort order
session <- sample(seq_along(x))
x_scrambled <- x[session]
dat <- data.frame(
  x = x_scrambled,
  session = session,
  phase_pair = calc_phase_pairs(x_scrambled, session = session)
)
dat_sorted <- dat[order(session),]
identical(x, dat_sorted$x)

# With a grouped data.frame
library(dplyr)
Schmidt2007 %>%
  group_by(Behavior_type, Case_pseudonym) %>%
  mutate(phase_pair = calc_phase_pairs(Condition, session = Session_number))
```

Casey1978   *Casey (1978)*

Description

Data from a multiple baseline design across participant that evaluated the effectiveness of use of manual signs with verbalizations in improving appropriate communicative behavior and reducing inappropriate behavior. The study aimed to increase positive communicative behavior to 1 and reduce the proportion of intervals engaged in problem behavior to 0. These two outcomes were combined to create the dependent variable: proportion of communicative opportunities with a signed request. The variables are as follows:

- StudyID. Study identifier.
- StudyID_CaseID. Participant identifier.
- Session_number. Within-series session-number.
- Condition. Indicates condition, (A for baseline, B for treatment).
- Outcome. Value for the outcome variable.
- Session_length. Length of the session.
- Procedure. Scale of the outcome variable.
- Goal_level. Indicates the goal level for each series.

Format

A data frame with 100 rows and 8 variables

Source

Casey, L. O. (1978). Development of communicative behavior in autistic children: A parent program using manual signs. *Journal of Autism and Childhood Schizophrenia, 8*(1), 45-59. https://doi.org/10.1007/BF01550277

Crozier2005   *Crozier and Tincani (2015)*

Description

Data from an ABAB design that evaluated a social story intervention on the disruptive behavior of a preschool child with autism. The dependent variable, number of disruptions, was measured using frequency counting for a thirty minute observation session. The variables are as follows:

- session. Within-series session-number.
- phase. Lable for each unique phase (e.g., A1 is the first baseline phase, B2 is the second treatment phase).
- score. Value for the outcome.

Format

A data frame with 24 rows and 3 variables

Source

Crozier, S., & Tincani, M. J. (2005). Using a modified social story to decrease disruptive behavior of a child with autism. Focus on Autism and Other Developmental Disabilities, 20(3), 150-157.

Dennis2021   *Dennis & Whalon, (2021)*

Description

Data from a Repeated acquisition single-case experimental design evaluating vocabulary knowledge using an expressive definition task. The variables are as follows:

- Participant. Participant identifier.
- Condition. Indicates condition, application (App) or teacher (TCH).
- Observation. Within-series session-number
- Pre. Pre-intervention score on the expressive definition task.
- Post. Post-intervention score on the expressive definition task.

Format

A data frame with 90 rows and 5 variables

Source

Dennis, L. R., & Whalon, K. J. (2021). Effects of teacher-versus application-delivered instruction on the expressive vocabulary of at-risk preschool children. Remedial and Special Education, 42(4), 195-206. doi:10.1177/0741932519900991

English1997 *English, et al. (1997)*

Description

Data from a multiple baseline design across participants conducted by English, et al. (1997), which evaluated the effects of peer-training on interaction skills. This dependent variable, number of communicative acts directed by the participant to their peers, was measured using frequency counting for a 10-minute observation session. The variables are as follows:

- case. Participant pseudonym given by author

- session. Within-series session-number

- phase. Label for each unique phase (A for baseline, B for treatment)

- score. Value for the outcome.

Format

A data frame with 59 rows and 4 variables

Source

English, K., Goldstein, H., Shafer, K., & Kaczmarek, L. (1997). Promoting interactions among preschoolers with and without disabilities: Effects of a buddy skills-training program. Exceptional Children, 63(2), 229-243.

Facon2008 *Facon, et al. (2008)*

Description

Data from a changing criterion design conducted by Facon, et al. (2008), which evaluated two operant learning procedures, shaping and fading, for treating selective mutism. The dependent variable, average speech loudness in dB, was measured during 15-minute observation sessions. The variables are as follows:

- session. Within-series session-number
- phase. Label for each unique phase (A for baseline, each following for a change in criteria.
- score. Value for the outcome.
- criterion. The fixed criterion value for each of the phases. The student moved to the next criterion when 80

Format

A data frame with 49 rows and 4 variables

Source

Facon, B., Sahiri, S., & Riviere, V. (2008). A controlled single-case treatment of severe long-term selective mutism in a child with mental retardation. Behavior Therapy, 39, 313-321

---

gem_scd *A function to estimate the gradual effects model for an SCD*

Description

A function to estimate the gradual effects model for an SCD

Usage

```
gem_scd(Trt, outcome, m, fam)
```

Arguments

Trt	A vector of treatment assignments where 0 = untreated and 1 = treated.
outcome	A vector of outcomes.
m	The number of treatment occasions to estimate a treatment effect for.
fam	A description of the error distribution and link function to be used in the model. This can be supplied in any way that 'glm' will accept. (See family for details of family functions.)

Value

'gem_scd' returns an object of class glm. In addition to the normal contents of a glm object, it also contains an estimate of 'omega' and a variance covariance matrix called 'varcov'.

IRD   *Robust improvement rate difference*

Description

Calculates the robust improvement rate difference index (Parker, Vannest, & Brown, 2009). The range of IRD depends on the number of observations in each phase.

Usage

```
IRD(
  A_data,
  B_data,
  condition,
  outcome,
  baseline_phase = NULL,
  intervention_phase = NULL,
  improvement = "increase"
)
```

Arguments

A_data	vector of numeric data for A phase. Missing values are dropped.
B_data	vector of numeric data for B phase. Missing values are dropped.
condition	vector identifying the treatment condition for each observation in the series.
outcome	vector of outcome data for the entire series.
baseline_phase	character string specifying which value of condition corresponds to the baseline phase. Defaults to first observed value of condition.
intervention_phase	
	character string specifying which value of condition corresponds to the intervention phase. Defaults to second unique value of condition.
improvement	character string indicating direction of improvement. Default is "increase".

Value

Numeric value

References

Parker, R. I., Vannest, K. J., & Brown, L. (2009). The improvement rate difference for single-case research. *Exceptional Children, 75*(2), 135–150. doi:doi:10.1177/001440290907500201

See Also

Examples

```
A <- c(20, 20, 26, 25, 22, 23)
B <- c(28, 25, 24, 27, 30, 30, 29)
IRD(A_data = A, B_data = B)
```

Kelley2015   *Kelley et al. (2015)*

Description

Data from a randomized control trial with embedded repeated acquisition single- case experimental design evaluating vocabulary knowledge using an expressive definition task. The variables are as follows:

- condition. Indicates whether control or treatment group.

- observation. Identifier for participant

- unit. Classroom unit.

- Pre. Pre-intervention score on the expressive definition task.

- Post. Post-intervention score on the expressive definition task.

Format

A data frame with 54 rows and 5 variables

Source

Kelley, E. S., Goldstein, H., Spencer, T., & Sherman, A. (2015). Effects of automated Tier 2 storybook intervention on vocabulary and comprehension learning in preschool children with limited oral language skills. Early Childhood Research Quarterly, 31, 47-61. doi:10.1016/j.ecresq.2014.12.004

LOR *Log-odds ratio*

Description

Calculates the log-odds ratio effect size index, with or without bias correction (Pustejovsky, 2015)

Usage

```
LOR(
  A_data,
  B_data,
  condition,
  outcome,
  baseline_phase = NULL,
  intervention_phase = NULL,
  improvement = "increase",
  scale = "percentage",
  intervals = NULL,
  D_const = NULL,
  bias_correct = TRUE,
  confidence = 0.95
)
```

Arguments

`A_data`	vector of numeric data for A phase. Missing values are dropped.
`B_data`	vector of numeric data for B phase. Missing values are dropped.
`condition`	vector identifying the treatment condition for each observation in the series.
`outcome`	vector of outcome data for the entire series.
`baseline_phase`	character string specifying which value of `condition` corresponds to the baseline phase. Defaults to first observed value of `condition`.
`intervention_phase`	character string specifying which value of `condition` corresponds to the intervention phase. Defaults to second unique value of `condition`.
`improvement`	character string indicating direction of improvement. Default is "increase".
`scale`	character string indicating the scale of the outcome variable. Must be either `"percentage"` for percentages with range 0-100 or `"proportion"` for proportions with range 0-1. If a vector, the most frequent unique value will be used. `"percentage"` is assumed by default.
`intervals`	for interval recording procedures, the total number of intervals per observation session. If a vector, the mean number of intervals will be used.
`D_const`	constant used for calculating the truncated sample mean (see Pustejovsky, 2015). If a vector, the mean value will be used.

bias_correct   logical value indicating whether to use bias-correction. Default is `TRUE`.

confidence   confidence level for the reported interval estimate. Set to `NULL` to omit confidence interval calculations.

Details

The odds ratio parameter is the ratio of the odds of the outcome. The log-odds ratio is the natural logarithm of the odds ratio. This effect size is appropriate for outcomes measured on a percentage or proportion scale. Unlike the LRRd and LRRi, the LOR is symmetric in valence, so that the LOR for an positively-valenced outcome is equal to -1 times the LOR calculated after reversing the scale of the outcome so that it is negatively valenced.

Without bias correction, the log-odds ratio is estimated by substituting the sample mean level in each phase in place of the corresponding parameter. A delta-method bias correction to the estimator is used by default.

The standard error of LOR is calculated based on a delta-method approximation, allowing for the possibility of different degrees of dispersion in each phase. The confidence interval for LOR is based on a large-sample (z) approximation.

To account for the possibility of sample means of zero, a truncated mean is calculated following the method described in Pustejovsky (2015). Truncated sample variances are also calculated to ensure that standard errors will be strictly larger than zero. The truncation constant depends on the total number of intervals per session (or the total number of items for other percentage/proportion scales). The arguments `scale` and `intervals` must be specified in order to calculate an appropriate truncation constant. For outcomes measured using continuous recording procedures, set `intervals` equal to 60 times the length of the observation session in minutes.

Value

A data.frame containing the estimate, standard error, and approximate confidence interval.

References

Pustejovsky, J. E. (2015). Measurement-comparable effect sizes for single-case studies of free-operant behavior. *Psychological Methods, 20*(3), 342–359. doi:doi:10.1037/met0000019

Examples

```
A_pct <- c(20, 20, 25, 25, 20, 25)
B_pct <- c(30, 25, 25, 25, 35, 30, 25)
LOR(A_data = A_pct, B_data = B_pct,
    scale = "percentage", intervals = 20, bias_correct = FALSE)
LOR(A_data = A_pct, B_data = B_pct,
    scale = "percentage", intervals = 20)

LOR(A_data = A_pct, B_data = B_pct, scale = "percentage")
LOR(A_data = A_pct / 100, B_data = B_pct / 100, scale = "proportion")
LOR(A_data = A_pct, B_data = B_pct, scale = "percentage", improvement = "decrease")
```

LRM   *Log ratio of medians*

Description

Calculates the log ratio of medians effect size index

Usage

```
LRM(
  A_data,
  B_data,
  condition,
  outcome,
  baseline_phase = NULL,
  intervention_phase = NULL,
  improvement = "increase",
  delta_method = FALSE,
  confidence = 0.95
)
```

Arguments

`A_data`	vector of numeric data for A phase. Missing values are dropped.
`B_data`	vector of numeric data for B phase. Missing values are dropped.
`condition`	vector identifying the treatment condition for each observation in the series.
`outcome`	vector of outcome data for the entire series.
`baseline_phase`	character string specifying which value of `condition` corresponds to the baseline phase. Defaults to first observed value of `condition`.
`intervention_phase`	
	character string specifying which value of `condition` corresponds to the intervention phase. Defaults to second unique value of `condition`.
`improvement`	character string indicating direction of improvement. Default is "increase".
`delta_method`	logical value indicating whether to use delta method to approximate variance of log ratio of medians. Default is `FALSE`, which estimates the variance based on the fact that the logarithm of a median is the same as the median of the log-transformed outcomes. If `TRUE`, the variance of log ratio of medians is approximated using delta method.
`confidence`	confidence level for the reported interval estimate. Set to `NULL` to omit confidence interval calculations.

Details

The ratio of medians effect size parameter is defined as the ratio of the medians of the outcomes in different phases. The log ratio of the medians is the natural logarithm of the ratio of medians. This effect size is appropriate for outcomes that are skewed, symmetric but highly leptokurtic, or right-censored (Bonett & Price Jr, 2020).

Value

A data frame containing the estimate, standard error, and confidence interval.

References

Bonett, D. G. & Price Jr, R. M. (2020). Confidence Intervals for Ratios of Means and Medians. *Journal of Educational and Behavioral Statistics, 45*(6), 750–770. doi:doi:10.3102/1076998620934125

Bonett, D. G., & Price, R. M. (2020). Interval estimation for linear functions of medians in within-subjects and mixed designs. *British Journal of Mathematical and Statistical Psychology, 73*(2), 333-346. doi:doi:10.1111/bmsp.12171

Examples

```
A <- c(20, 20, 26, 25, 22, 23)
B <- c(28, 25, 24, 27, 30, 30, 29)
LRM(A_data = A, B_data = B)
```

LRR   *Log-response ratio*

Description

Calculates the increasing or decreasing version of the log-response ratio effect size index, with or without bias correction (Pustejovsky, 2015)

Usage

```
LRRd(
  A_data,
  B_data,
  condition,
  outcome,
  baseline_phase = NULL,
  intervention_phase = NULL,
  improvement = "decrease",
  scale = "count",
  observation_length = NULL,
  intervals = NULL,
  D_const = NULL,
  bias_correct = TRUE,
  pct_change = FALSE,
  confidence = 0.95
)

LRRi(
  A_data,
```

```
  B_data,
  condition,
  outcome,
  baseline_phase = NULL,
  intervention_phase = NULL,
  improvement = "increase",
  scale = "count",
  observation_length = NULL,
  intervals = NULL,
  D_const = NULL,
  bias_correct = TRUE,
  pct_change = FALSE,
  confidence = 0.95
)
```

Arguments

`A_data`	vector of numeric data for A phase. Missing values are dropped.
`B_data`	vector of numeric data for B phase. Missing values are dropped.
`condition`	vector identifying the treatment condition for each observation in the series.
`outcome`	vector of outcome data for the entire series.
`baseline_phase`	character string specifying which value of `condition` corresponds to the baseline phase. Defaults to first observed value of `condition`.
`intervention_phase`	character string specifying which value of `condition` corresponds to the intervention phase. Defaults to second unique value of `condition`.
`improvement`	character string indicating direction of improvement. Default is "increase".
`scale`	character string indicating the scale of the outcome variable, with possible values `"percentage"` for a percentage with range 0-100, `"proportion"` for a proportion with range 0-1, `"count"` for a frequency count (0 or positive integers), `"rate"` for a standardized rate per minute. If a vector, the most frequent unique value will be used.
`observation_length`	length of observation session (in minutes). If a vector, the mean observation session length will be used.
`intervals`	for interval recording procedures, the total number of intervals per observation session. If a vector, the mean number of intervals will be used.
`D_const`	constant used for calculating the truncated sample mean (see Pustejovsky, 2018). If a vector, the mean value will be used.
`bias_correct`	logical value indicating whether to use bias-correction. Default is `TRUE`.
`pct_change`	logical value indicating whether to convert the LRR estimate and confidence interval into percentage change.
`confidence`	confidence level for the reported interval estimate. Set to `NULL` to omit confidence interval calculations.

Details

The response ratio parameter is the ratio of the mean level of the outcome during phase B to the mean level of the outcome during phase A. The log response ratio is the natural logarithm of the response ratio. This effect size is appropriate for outcomes measured on a ratio scale (so that zero corresponds to the true absence of the outcome. There are two versions of the LRR. The LRR-increasing (`LRRi`) is defined so that positive values correspond to therapeutic improvements. The LRR-decreasing (`LRRd`) is defined so that negative values correspond to therapeutic improvements. For outcomes measured as frequency counts or rates, the two versions will have the same magnitude but opposite sign; for outcomes measured as percentages or proportions, the LRRd and LRRi will differ in both sign and magnitude (Pustejovsky, 2018).

Without bias correction, the log response ratio is estimated as the natural logarithm of the phase B sample mean, minus the natural logarithm of the phase A sample mean. A delta-method bias correction to the estimator is used by default.

The standard error of LRR is calculated based on a delta-method approximation, allowing for the possibility of different degrees of dispersion in each phase. The confidence interval for LRR is based on a large-sample (z) approximation.

To account for the possibility of sample means of zero, a truncated mean is calculated following the method described in Pustejovsky (2018). Truncated sample variances are also calculated to ensure that standard errors will be strictly larger than zero. The truncation constant depends on the scale of the outcome, the length of the observation sessions used to measure the dependent variable, and (for interval recording procedures) the total number of intervals per session (or the total number of items for other percentage/proportion scales). The argument `scale` must be specified in order to calculate an appropriate truncation constant. For standardized rates, the argument `observation_length` must also be specified; for percentages or proportions, the argument `intervals` must be specified. For outcomes measured using continuous recording procedures, set `intervals` equal to 60 times the length of the observation session in minutes.

If `pct_change` is `TRUE`, then the LRR estimate and confidence interval are converted into percentage change using the formula Percentage change = 100 * (exp(LRR) - 1).

Value

A data.frame containing the estimate, standard error, and approximate confidence interval.

References

Pustejovsky, J. E. (2015). Measurement-comparable effect sizes for single-case studies of free-operant behavior. *Psychological Methods, 20*(3), 342–359. doi:doi:10.1037/met0000019

Pustejovsky, J. E. (2018). Using response ratios for meta-analyzing single-case designs with behavioral outcomes. *Journal of School Psychology, 16*, 99-112. doi:doi:10.1016/j.jsp.2018.02.003

Examples

```
A <- c(20, 20, 26, 25, 22, 23)
B <- c(28, 25, 24, 27, 30, 30, 29)
LRRd(A_data = A, B_data = B, bias_correct = FALSE)
LRRd(A_data = A, B_data = B)
LRRd(A_data = A, B_data = B, pct_change = TRUE)
```

McKissick   *McKissick et al. (2010)*

Description

Disruptive behavior data from a study by McKissick et al. (2010). All data were collected via event counting. The variables are as follows:

- Case_Pseudonym. Case Pseudonym provided by the authors.
- Session_number. Within-series session-number
- Condition. Describes whether the outcome is in the baseline (A) or treatment (B) phase.
- Outcome. Value for the outcome.
- Session_length. Length of the observation session.
- Procedure. The metric in which the outcome measurement is expressed, all "count".
- Session_length. The length of the observation session.

Format

A data frame with 35 rows and 4 variables

Source

McKissick, C., Hawkins, R. O., Lentz, F. E., Hailley, J., & McGuire, S. (2010). Randomizing multiple contingency components to decrease disruptive behaviors and increase student engagement in an urban second-grade classroom. *Psychology in the Schools, 47*(9), 944-959. https://doi.org/10.1002/pits.20516

NAP   *Non-overlap of all pairs*

Description

Calculates the non-overlap of all pairs index (Parker & Vannest, 2009).

Usage

```
NAP(
  A_data,
  B_data,
  condition,
  outcome,
  baseline_phase = NULL,
  intervention_phase = NULL,
  improvement = "increase",
  SE = "unbiased",
  confidence = 0.95,
  trunc_const = FALSE
)
```

Arguments

`A_data`	vector of numeric data for A phase. Missing values are dropped.
`B_data`	vector of numeric data for B phase. Missing values are dropped.
`condition`	vector identifying the treatment condition for each observation in the series.
`outcome`	vector of outcome data for the entire series.
`baseline_phase`	character string specifying which value of `condition` corresponds to the baseline phase. Defaults to first observed value of `condition`.
`intervention_phase`	
	character string specifying which value of `condition` corresponds to the intervention phase. Defaults to second unique value of `condition`.
`improvement`	character string indicating direction of improvement. Default is "increase".
`SE`	character value indicating which formula to use for calculating the standard error of NAP, with possible values `"unbiased"` for the exactly unbiased estimator, `"Hanley"` for the Hanley-McNeil estimator, `"null"` for the (known) variance under the null hypothesis of no effect, or `"none"` to not calculate a standard error. Defaults to "unbiased".
`confidence`	confidence level for the reported interval estimate. Set to `NULL` to omit confidence interval calculations.
`trunc_const`	logical value indicating whether to return the truncation constant used to calculate the standard error.

Details

NAP is calculated as the proportion of all pairs of one observation from each phase in which the measurement from the B phase improves upon the measurement from the A phase, with pairs of data points that are exactly tied being given a weight of 0.5. The range of NAP is [0,1], with a null value of 0.5.

The unbiased variance estimator was described by Sen (1967) and Mee (1990). The Hanley estimator was proposed by Hanley and McNeil (1982). The null variance is a known function of sample size, equal to the exact sampling variance when the null hypothesis of no effect holds. When the null hypothesis does not hold, the null variance will tend to over-estimate the true sampling variance of NAP.

The confidence interval for NAP is calculated based on the symmetrized score-inversion method (Method 5) proposed by Newcombe (2006).

Value

A data.frame containing the estimate, standard error, and/or confidence interval.

References

Hanley, J. A., & McNeil, B. J. (1982). The meaning and use of the area under a receiver operating characteristic (ROC) curve. *Radiology, 143*, 29–36. doi:doi:10.1148/radiology.143.1.7063747

Mee, W. (1990). Confidence intervals for probabilities and tolerance regions based on a generalization of the Mann-Whitney statistic. *Journal of the American Statistical Association, 85*(411), 793-800. doi:doi:10.1080/01621459.1990.10474942

Newcombe, R. G. (2006). Confidence intervals for an effect size measure based on the Mann-Whitney statistic. Part 2: Asymptotic methods and evaluation. *Statistics in Medicine, 25*(4), 559–573. doi:doi:10.1002/sim.2324

Parker, R. I., & Vannest, K. J. (2009). An improved effect size for single-case research: Nonoverlap of all pairs. *Behavior Therapy, 40*(4), 357–67. doi:doi:10.1016/j.beth.2008.10.006

Sen, P. K. (1967). A note on asymptotically distribution-free confidence bounds for P{X<Y}, based on two independent samples. *The Annals of Mathematical Statistics, 29*(1), 95-102. https://www.jstor.org/stable/25049448

Examples

```
A <- c(20, 20, 26, 25, 22, 23)
B <- c(28, 25, 24, 27, 30, 30, 29)
NAP(A_data = A, B_data = B)

# Example from Parker & Vannest (2009)
yA <- c(4, 3, 4, 3, 4, 7, 5, 2, 3, 2)
yB <- c(5, 9, 7, 9, 7, 5, 9, 11, 11, 10, 9)
NAP(yA, yB)
```

Olszewski2017   *Olszewski, et al. (2017)*

Description

Data from a multiple baseline design across behavior looking at four fluency measures (blends, segmenting, first part ID, first sound ID). The dependent variable is a score on a subtest, with a maximum score of 20. The variables are as follows:

- behavior. Outcome measure description (blends, segmenting, first part ID, or first sound ID)
- session. Within-series session-number
- phase. Label for each unique phase (A for baseline, B for treatment)
- score. Value for the outcome.
- Include. Value for inclusion in POGO calculation (0 if included in article, 1 if not included)

Format

A data frame with 72 rows and 4 variables

Source

Olszewski, A., Soto, X., & Goldstein, H. (2017). Modeling alphabet skills as instructive feedback within a phonological awareness intervention. American Journal of Speech-Language Pathology, 26(3), 769-790. doi:10.1044/2017_AJSLP-16-0042

PAND   *Percentage of all non-overlapping data (PAND)*

Description

Calculates the percentage of all non-overlapping data index (Parker, Hagan-Burke, & Vannest, 2007; Parker, Vannest, & Davis, 2011).

Usage

```
PAND(
  A_data,
  B_data,
  condition,
  outcome,
  baseline_phase = NULL,
  intervention_phase = NULL,
  improvement = "increase"
)
```

Arguments

`A_data`	vector of numeric data for A phase. Missing values are dropped.
`B_data`	vector of numeric data for B phase. Missing values are dropped.
`condition`	vector identifying the treatment condition for each observation in the series.
`outcome`	vector of outcome data for the entire series.
`baseline_phase`	character string specifying which value of `condition` corresponds to the baseline phase. Defaults to first observed value of `condition`.
`intervention_phase`	
	character string specifying which value of `condition` corresponds to the intervention phase. Defaults to second unique value of `condition`.
`improvement`	character string indicating direction of improvement. Default is "increase".

Details

For an outcome where increase is desirable, PAND is calculated as the proportion of observations remaining after removing the fewest possible number of observations from either phase so that the highest remaining point from the baseline phase is less than the lowest remaining point from the treatment phase. For an outcome where decrease is desirable, PAND is calculated as the proportion of observations remaining after removing the fewest possible number of observations from either phase so that the lowest remaining point from the baseline phase is greater than the highest remaining point from the treatment phase. The range of PAND depends on the number of observations in each phase.

Value

Numeric value

References

Parker, R. I., Hagan-Burke, S., & Vannest, K. J. (2007). Percentage of all non-overlapping data (PAND): An alternative to PND. *The Journal of Special Education, 40*(4), 194–204. doi:doi:10.1177/00224669070400040101

Parker, R. I., Vannest, K. J., & Davis, J. L. (2011). Effect size in single-case research: A review of nine nonoverlap techniques. *Behavior Modification, 35*(4), 303–22. doi:doi:10.1177/0145445511399147

Examples

```
A <- c(20, 20, 26, 25, 22, 23)
B <- c(28, 25, 24, 27, 30, 30, 29)
PAND(A_data = A, B_data = B)
```

PEM   *Percentage exceeding the median*

Description

Calculates the percentage exceeding the median (PEM) index (Ma, 2006).

Usage

```
PEM(
  A_data,
  B_data,
  condition,
  outcome,
  baseline_phase = NULL,
  intervention_phase = NULL,
  improvement = "increase"
)
```

Arguments

A_data	vector of numeric data for A phase. Missing values are dropped.
B_data	vector of numeric data for B phase. Missing values are dropped.
condition	vector identifying the treatment condition for each observation in the series.
outcome	vector of outcome data for the entire series.
baseline_phase	character string specifying which value of condition corresponds to the baseline phase. Defaults to first observed value of condition.

```
intervention_phase
```
> character string specifying which value of `condition` corresponds to the intervention phase. Defaults to second unique value of `condition`.

```
improvement
```
character string indicating direction of improvement. Default is "increase".

Details

For an outcome where increase is desirable, PEM is calculated as the proportion of observations in the B phase that exceed the median observation from the A phase. For an outcome where decrease is desirable, PEM is calculated as the proportion of observations in the B phase that are less than the median observation from the A phase. Ties are counted with a weight of 0.5. The range of PEM is [0,1].

Value

Numeric value

References

Ma, H.-H. (2006). An alternative method for quantitative synthesis of single-subject researches: Percentage of data points exceeding the median. *Behavior Modification, 30*(5), 598–617. doi:doi:10.1177/0145445504272974

Examples

```
A <- c(20, 20, 26, 25, 22, 23)
B <- c(28, 25, 24, 27, 30, 30, 29)
PEM(A_data = A, B_data = B)
```

Peters2020   *Peters-Sanders et al. (2020)*

Description

Data from a Repeated acquisition single-case experimental design evaluating vocabulary knowledge using an expressive definition task. The variables are as follows:

- observation. Identifier for participant
- Book.Book used for evaluation.
- Pre. Pre-intervention score on the expressive definition task.
- Post. Post-intervention score on the expressive definition task.

Format

A data frame with 153 rows and 4 variables

Source

Peters-Sanders, L., Kelley, E., Haring, C., Madsen, K., Soto, X., Seven, Y., Hull, K., & Goldstein, H. (2020). Moving forward four words at a time: Effects of a supplemental preschool vocabulary. Language, Speech, and Hearing Services in Schools, 51, 165-175. doi:10.1044/2019_LSHSS-19-00029

PND   *Percentage of non-overlapping data*

Description

Calculates the percentage of non-overlapping data index (Scruggs, Mastropieri, & Castro, 1987).

Usage

```
PND(
  A_data,
  B_data,
  condition,
  outcome,
  baseline_phase = NULL,
  intervention_phase = NULL,
  improvement = "increase"
)
```

Arguments

A_data	vector of numeric data for A phase. Missing values are dropped.
B_data	vector of numeric data for B phase. Missing values are dropped.
condition	vector identifying the treatment condition for each observation in the series.
outcome	vector of outcome data for the entire series.
baseline_phase	character string specifying which value of condition corresponds to the baseline phase. Defaults to first observed value of condition.
intervention_phase	
	character string specifying which value of condition corresponds to the intervention phase. Defaults to second unique value of condition.
improvement	character string indicating direction of improvement. Default is "increase".

Details

For an outcome where increase is desirable, PND is calculated as the proportion of observations in the B phase that exceed the highest observation from the A phase. For an outcome where decrease is desirable, PND is the proportion of observations in the B phase that are less than the lowest observation from the A phase. The range of PND is [0,1].

Value

Numeric value

References

Scruggs, T. E., Mastropieri, M. A., & Casto, G. (1987). The quantitative synthesis of single-subject research: Methodology and validation. *Remedial and Special Education, 8*(2), 24–43. doi:doi:10.1177/074193258700800206

Examples

```
A <- c(20, 20, 26, 25, 22, 23)
B <- c(28, 25, 24, 27, 30, 30, 29)
PND(A_data = A, B_data = B)
```

PoGO   *Percent of Goal Obtained*

Description

Calculates the percent of goal obtained effect size index

Usage

```
PoGO(
  A_data,
  B_data,
  condition,
  outcome,
  goal,
  baseline_phase = NULL,
  intervention_phase = NULL,
  improvement = "increase",
  confidence = 0.95
)
```

Arguments

A_data	vector of numeric data for A phase. Missing values are dropped.
B_data	vector of numeric data for B phase. Missing values are dropped.
condition	vector identifying the treatment condition for each observation in the series.
outcome	vector of outcome data for the entire series.
goal	a numerical value indicating the goal level of behavior.
baseline_phase	character string specifying which value of condition corresponds to the baseline phase. Defaults to first observed value of condition.

intervention_phase

        character string specifying which value of `condition` corresponds to the intervention phase. Defaults to second unique value of `condition`.

improvement   character string indicating direction of improvement. Default is "increase".

confidence   confidence level for the reported interval estimate. Set to `NULL` to omit confidence interval calculations.

Details

The percent of goal obtained (PoGO) effect size parameter is defined as the ratio of the difference in the mean level of behavior during phase B versus during phase A to the difference between the goal level of behavior and the mean level of behavior during phase A, multiplied by 100.

The standard error of PoGO is calculated based on Dunlap and Silver's (1986) approximation for the standard error of a ratio. The confidence interval for LRR is based on a large-sample (z) approximation.

Value

A data frame containing the estimate, standard error, and confidence interval.

References

Dunlap, W. P., & Silver, N. C. (1986). Confidence intervals and standard error for ratios of normal variables. *Behavior Research Methods, Instruments, & Computers, 18*, 469-471. doi:doi:10.3758/BF03201412

Ferron, J., Goldstein, H., Olszewski, A., & Rohrer, L. (2020). Indexing effects in single-case experimental designs by estimating the percent of goal obtained. *Evidence-Based Communication Assessment and Intervention, 14*(1-2), 6-27. doi:doi:10.1080/17489539.2020.1732024

Patrona, E., Ferron, J., Olszewski, A., Kelley, E., & Goldstein, H. (2022). Effects of explicit vocabulary interventions for preschoolers: An exploratory application of the percent of goal obtained (PoGO) effect size metric. *Journal of Speech, Language, and Hearing Research*, forthcoming.

Examples

```
A <- c(20, 20, 26, 25, 22, 23)
B <- c(28, 25, 24, 27, 30, 30, 29)
PoGO(A_data = A, B_data = B, goal = 30)
```

SCD_effect_sizes   *SCD effect size calculator*

Description

An interactive tool for calculating effect size indices for single-case designs.

Usage

```
SCD_effect_sizes(browser = TRUE)
```

Arguments

browser   logical value indicating whether to launch the app in the system's default web-
               browser. Defaults to TRUE.

Schmidt2007   *Schmidt (2007)*

Description

Data from a study by Schmidt (2007). The variables are as follows:

- Behavior_type. Outcome measure description (disruptive behavior or on task behavior).
- Procedure. The observation recording procedure used to measure the outcome.
- Metric. The metric in which the outcome measurement is expressed ("count" for natural counts; "percentage" for percentage of intervals)
- Session_length. Length (in minutes) of the observation sessions
- Interval_length. If an interval method was used, the length of the intervals (in seconds); NA otherwise.
- Case_Pseudonym. Case Pseudonym provided by the authors.
- Session_number. Within-series session-number.
- Phase. Label for each unique phase (e.g., A1 is the first baseline phase, B2 is the second treatment phase).
- Condition. Label indicating whether the outcome is in the baseline (A) or treatment (B) phase.
- Outcome. Outcome measurement.
- Phase_num. Indicator for each pair of baseline and treatment phases.
- direction. Direction of therapeutic improvement for the outcome.
- n_Intervals. If an interval method was used, the total number of intervals; NA otherwise.

Format

A data frame with 172 rows and 13 variables

Note

Data were reconstructed from figures in the source document. Consequently, outcome measurements in this dataset include additional error from the reconstruction process and may not exactly match the original source data.

In earlier versions of the package (0.5.0 and earlier), the Case_Pseudonym variable contained incorrect labels for each case, which did not match the labels in the source document. Specifically, Faith was incorrectly labeled as Albert; Lilly was incorrectly labeled as Faith; and Albert was incorrectly labeled as Lilly.

Source

Schmidt, A. C. (2007). The effects of a group contingency on group and individual behavior in an urban first-grade classroom. Masters Thesis, University of Kansas, Department of Applied Behavioral Sciences. ProQuest Dissertations & Theses Global, thesis number 1443719. https://kuscholarworks.ku.edu/bitstream/ha

---

Schmidt2012 *Schmidt and Stichter (2012)*

Description

Data from an ABAB design conducted by Schmidt and Stichter (2012). All data were collected via continuous recording. The variables are as follows:

- Case. Participant identifier.
- Behavior. Behavior type (Conversation, Initiations, or Responses).
- Trt Treatment indicators.
- Outcome. Outcome scores.
- Session_num. Measurement occasion.
- Session_length Length of the observation session.
- Procedure The metric in which the outcome measurement is expressed, all "other".

Format

A data frame with 180 rows and 5 variables

Source

Schmidt, C., & Stichter, J. P. (2012). The use of peer-mediated interventions to promote the generalization of social competence for adolescents with high-functioning autism and Asperger's syndrome. *Exceptionality*, 20(2), 94-113. doi:10.1080/09362835.2012

---

shine_gem_scd *Gradual Effects Model SCD Calculator*

Description

Open an interactive tool for calculating the gradual effects model for SCDs.

Usage

```
shine_gem_scd(browser = TRUE)
```

Arguments

browser   logical value indicating whether to launch the app in the system's default web-browser. Defaults to TRUE.

Examples

```
## Not run:
shine_gem_scd()

## End(Not run)
```

Shogren   *Shogren et al. (2004)*

Description

Data from a systematic review by Shogren et al. (2004) on the effects of choice-making interventions. These data were compiled and re-analyzed in Pustejovsky (2015). The variables are as follows:

- Study. An ID for each study in the systematic review.

- Case. Case Pseudonym provided by the authors.

- Measure. Type of behavior observed as the outcome measure

- Phase. Phase indicator, baseline phase is "No Choice" and treatment phase is "Choice."

- Percentage. For those outcomes measured as percentage, outcomes value. NA for count outcomes.

- Observed. For those outcomes measured as count, outcome value. NA for percentage outcomes.

- Possible. For counts out of a maximum, lists the maximum value.

- Recording_procedure Recording procedure. CDR = "Continuous Duration Recording", EC = "Event Counting", "MTS = "Momentary Time Sampling", and PIR = "Partial Interval Recording."

- Session_length. Length of the observation session in minutes.

- interval_length. Length of the observation intervals for data observed using MTS or PIR.

- outcome. Value for the outcome for all outcome types.

- direction. Direction of therapeutic improvement for the outcome.

Format

A data frame with 634 rows and 15 variables

Source

Shogren, K. A., Faggella-Luby, M. N., Bae, S. J., & Wehmeyer, M. L. (2004). The effect of choice-making as an intervention for problem behavior. *Journal of Positive Behavior Interventions, 6*(4), 228-237.

References

Pustejovsky, J.E. (2015). Measurement-comparable effect sizes for single-case studies of free-operant behavior. *Psychological Methods, 20*(3), 342-359.

SMD	*Within-case standardized mean difference*

Description

Calculates the within-case standardized mean difference effect size index

Usage

```
SMD(
  A_data,
  B_data,
  condition,
  outcome,
  baseline_phase = NULL,
  intervention_phase = NULL,
  improvement = "increase",
  std_dev = "baseline",
  bias_correct = TRUE,
  confidence = 0.95
)
```

Arguments

A_data	vector of numeric data for A phase. Missing values are dropped.
B_data	vector of numeric data for B phase. Missing values are dropped.
condition	vector identifying the treatment condition for each observation in the series.
outcome	vector of outcome data for the entire series.
baseline_phase	character string specifying which value of condition corresponds to the baseline phase. Defaults to first observed value of condition.
intervention_phase	
	character string specifying which value of condition corresponds to the intervention phase. Defaults to second unique value of condition.
improvement	character string indicating direction of improvement. Default is "increase".

std_dev   character string controlling how to calculate the standard deviation in the de-
                 nominator of the effect size. Set to "baseline" (the default) to use the baseline
                 standard deviation. Set to "pool" to use the pooled standard deviation.

bias_correct   logical value indicating whether to use bias-correction (i.e., Hedges' g). Default
                 is TRUE

confidence   confidence level for the reported interval estimate. Set to NULL to omit confi-
                 dence interval calculations.

Details

The standardized mean difference parameter is defined as the difference between the mean level of
the outcome in phase B and the mean level of the outcome in phase A, scaled by the within-case
standard deviation of the outcome in phase A. The parameter is estimated using sample means and
sample standard deviations and (optionally) making a small-sample correction.

By default, the scaling factor is estimated using the sample standard deviation in phase A (the
baseline phase) only. Set std_dev = "pool" to use the sample standard deviation pooled across
both phases. Hedges' (1981) small-sample bias correction is applied by default.

Value

A list containing the estimate, standard error, and confidence interval.

Examples

```
A <- c(20, 20, 26, 25, 22, 23)
B <- c(28, 25, 24, 27, 30, 30, 29)
SMD(A_data = A, B_data = B, bias_correct = FALSE)
SMD(A_data = A, B_data = B)
SMD(A_data = A, B_data = B, std_dev = "pool")
```

Spencer2012   *Spencer et al. (2012)*

Description

Data from a repeated acquisition single-case experimental design evaluating vocabulary knowledge
using an expressive definition task. The variables are as follows:

   • Observation. Participant number.

   • Book. Book used for evaluation.

   • Pre. Pre-intervention score on the expressive definition task.

   • Post. Post-intervention score on the expressive definition task.

Format

A data frame with 81 rows and 4 variables

Source

Spencer, E., Goldstein, H., Sherman, A., Noe, S., Tabbah, R., Ziolkowski, R., & Schneider, N. (2012). Effects of an automated vocabulary and comprehension intervention: An early efficacy study. Journal of Early Intervention, 34, 195-221. doi:10.1177/1053815112471990

Strasberger2014	*Strasberger & Ferreri (2014)*

Description

Data from a multiple baseline design across participant that evaluated the effectiveness of an iPod-based speech generating device and a peer mediated intervention on improving sophisticated communication skills of children with autism. The variables are as follows:

- StudyID. Study identifier.

- StudyID_CaseID. Participant identifier.

- Session_number. Within-series session-number.

- Condition. Indicates condition, (A for baseline, B for intervention).

- Outcome. The number of independent 2-step mands.

- Session_length. Length of the session.

- Procedure. Scale of the outcome variable.

- Goal_level. Indicates the goal level for each series.

Format

A data frame with 47 rows and 8 variables

Source

Strasberger, S. K., & Ferreri, S. J. (2014). The effects of peer assisted communication application training on the communicative and social behaviors of children with autism. *Journal of Developmental and Physical Disabilities, 26*, 513-526. https://doi.org/10.1007/s10882-013-9358-9

Tau   *Tau (non-overlap)*

Description

Calculates the Tau (non-overlap) index (Parker, Vannest, Davis, & Sauber 2011).

Usage

```
Tau(
  A_data,
  B_data,
  condition,
  outcome,
  baseline_phase = NULL,
  intervention_phase = NULL,
  improvement = "increase",
  SE = "unbiased",
  confidence = 0.95,
  trunc_const = FALSE
)
```

Arguments

A_data	vector of numeric data for A phase. Missing values are dropped.
B_data	vector of numeric data for B phase. Missing values are dropped.
condition	vector identifying the treatment condition for each observation in the series.
outcome	vector of outcome data for the entire series.
baseline_phase	character string specifying which value of condition corresponds to the baseline phase. Defaults to first observed value of condition.
intervention_phase	
	character string specifying which value of condition corresponds to the intervention phase. Defaults to second unique value of condition.
improvement	character string indicating direction of improvement. Default is "increase".
SE	character value indicating which formula to use for calculating the standard error of NAP, with possible values "unbiased" for the exactly unbiased estimator, "Hanley" for the Hanley-McNeil estimator, "null" for the (known) variance under the null hypothesis of no effect, or "none" to not calculate a standard error. Defaults to "unbiased".
confidence	confidence level for the reported interval estimate. Set to NULL to omit confidence interval calculations.
trunc_const	logical value indicating whether to return the truncation constant used to calculate the standard error.

Details

Tau (non-overlap) a linear re-scaling of [NAP](NAP) to the range [-1,1], with a null value of 0.

Standard errors and confidence intervals for Tau are based on transformations of the corresponding SEs and CIs for [NAP](NAP).

Value

A list containing the estimate, standard error, and/or confidence interval.

References

Parker, R. I., Vannest, K. J., Davis, J. L., & Sauber, S. B. (2011). Combining nonoverlap and trend for single-case research: Tau-U. *Behavior Therapy, 42*(2), 284–299. doi:doi:10.1016/j.beth.2010.08.006

Examples

```
A <- c(20, 20, 26, 25, 22, 23)
B <- c(28, 25, 24, 27, 30, 30, 29)
Tau(A_data = A, B_data = B)
```

Tau_BC *Tau-BC*

Description

Calculates the baseline-corrected Tau index (Tarlow 2017).

Usage

```
Tau_BC(
  A_data,
  B_data,
  condition,
  outcome,
  baseline_phase = NULL,
  intervention_phase = NULL,
  improvement = "increase",
  SE = "unbiased",
  confidence = 0.95,
  trunc_const = FALSE,
  Kendall = FALSE,
  pretest_trend = FALSE,
  report_correction = FALSE,
  warn = TRUE
)
```

Arguments

`A_data`	vector of numeric data for A phase. Missing values are dropped.
`B_data`	vector of numeric data for B phase. Missing values are dropped.
`condition`	vector identifying the treatment condition for each observation in the series.
`outcome`	vector of outcome data for the entire series.
`baseline_phase`	character string specifying which value of `condition` corresponds to the baseline phase. Defaults to first observed value of `condition`.
`intervention_phase`	
	character string specifying which value of `condition` corresponds to the intervention phase. Defaults to second unique value of `condition`.
`improvement`	character string indicating direction of improvement. Default is "increase".
`SE`	character value indicating which formula to use for calculating the standard error of Tau-BC, with possible values `"unbiased"` for the exactly unbiased estimator, `"Hanley"` for the Hanley-McNeil estimator, `"null"` for the (known) variance under the null hypothesis of no effect, or `"none"` to not calculate a standard error. Defaults to "unbiased". Note that the "unbiased" standard error is unbiased for `Tau`, but not necessarily unbiased for `Tau_BC`. None of the standard error formulas account for the additional uncertainty due to use of the baseline trend correction.
`confidence`	confidence level for the reported interval estimate. Set to `NULL` to omit confidence interval calculations.
`trunc_const`	logical value indicating whether to return the truncation constant used to calculate the standard error.
`Kendall`	logical value indicating whether to use Kendall's rank correlation to calculate the Tau effect size measure. If `TRUE`, the Kendall's rank correlation (with adjustment for ties) is calculated between the data and a dummy coded phase variable, which is consistent with the method used in Tarlow (2017). Default is `FALSE`, which calculates `Tau` (non-overlap) index (without adjustment for ties).
`pretest_trend`	significance level for the initial baseline trend test. The raw data are corrected and `Tau_BC` is calculated only if the baseline trend is statistically significant. Otherwise, `Tau_BC` is equal to `Tau`. Default is `FALSE`, which always adjusts for the baseline trend.
`report_correction`	
	logical value indicating whether to report the baseline corrected slope and intercept values. Default is `FALSE`.
`warn`	logical value indicating whether to print a message regarding the outcome of the baseline trend test. Default is `TRUE`.

Details

Tau-BC is an elaboration of the `Tau` that includes a correction for baseline trend. The calculation of Tau-BC involves two or three steps, depending on the `pretest_trend` argument.

If `pretest_trend = FALSE` (the default), the first step involves adjusting the outcomes for baseline trend estimated using Theil-Sen regression. In the second step, the residuals from Theil-Sen regression are used to calculate the Tau (using either Kendall's rank correlation, with adjustment for ties, or computing Tau directly, without adjustment for ties).

Alternately, `pretest_trend` can be set equal to a significance level between 0 and 1 (e.g. `pretest_trend = .05`, as suggested by Tarlow (2017). In this case, the first step involves a significance test for the slope of the baseline trend based on Kendall's rank correlation. If the slope is not significantly different from zero, then no baseline trend adjustment is made and Tau-BC is set equal to `Tau` index. If the slope is significantly different from zero, then in the second step, the outcomes are adjusted for baseline trend using Theil-Sen regression. Then, in the third step, the residuals from Theil-Sen regression are used to calculate the `Tau` index. If `Kendall = FALSE` (the default), then `Tau` (non-overlap) index is calculated. If `Kendall = TRUE`, then Kendall's rank correlation is calculated, including adjustment for ties, as in Tarlow (2017).

Note that the standard error formulas are based on the standard errors for `Tau` (non-overlap) and they do not account for the additional uncertainty due to use of the baseline trend correction (nor to the pre-test for statistical significance of baseline trend, if used).

Value

A list containing the estimate, standard error, and/or confidence interval.

References

Tarlow, K. R. (2017). An improved rank correlation effect size statistic for single-case designs: Baseline corrected Tau. *Behavior modification, 41*(4), 427-467. doi:doi:10.1177/0145445516676750

See Also

Tau, Tau_U

Examples

```
A <- c(20, 20, 26, 25, 22, 23)
B <- c(28, 25, 24, 27, 30, 30, 29)
Tau_BC(A_data = A, B_data = B)
```

Tau_U *Tau-U*

Description

Calculates the Tau-U index with baseline trend correction (Parker, Vannest, Davis, & Sauber 2011).

Usage

```
Tau_U(
  A_data,
  B_data,
  condition,
  outcome,
  baseline_phase = NULL,
```

```
  intervention_phase = NULL,
  improvement = "increase"
)
```

Arguments

`A_data`	vector of numeric data for A phase, sorted in order of session number. Missing values are dropped.
`B_data`	vector of numeric data for B phase. Missing values are dropped.
`condition`	vector identifying the treatment condition for each observation in the series.
`outcome`	vector of outcome data for the entire series.
`baseline_phase`	character string specifying which value of `condition` corresponds to the base-line phase. Defaults to first observed value of `condition`.
`intervention_phase`	
	character string specifying which value of `condition` corresponds to the inter-vention phase. Defaults to second unique value of `condition`.
`improvement`	character string indicating direction of improvement. Default is "increase".

Details

Tau-U is an elaboration of the [Tau](#) that includes a correction for baseline trend. It is calculated as Kendall's S statistic for the comparison between the phase B data and the phase A data, plus Kendall's S statistic for the A phase observations, scaled by the product of the number of observations in each phase.

Note that `A_data` must be ordered by session number.

Value

Numeric value

References

Parker, R. I., Vannest, K. J., Davis, J. L., & Sauber, S. B. (2011). Combining nonoverlap and trend for single-case research: Tau-U. *Behavior Therapy, 42*(2), 284–299. doi:doi:10.1016/j.beth.2010.08.006

Examples

```
A <- c(20, 20, 26, 25, 22, 23)
B <- c(28, 25, 24, 27, 30, 30, 29)
Tau_U(A_data = A, B_data = B)
```

Thorne	*Thorne and Kamps (2008)*

Description

Data from an ABAB design conducted by Thorne and Kamps (2008). These data were used as an example in Swan and Pustejovsky (2017). Academic engagement was collected via continuous recording (marked as "other") and inappropriate verbalizations were collected via event counting (marked as "count"). The variables are as follows:

- Measure. Outcome measure description (academic engagement or inappropriate verbalizations).
- Case. Participant identifier.
- Session_number. Measurement occasion.
- Outcome. Outcome scores
- Trt. Treatment indicators.
- Session_length. Length of the observation session.
- Measure. The metric in which the outcome measurement is expressed (count or other).

Format

A data frame with 776 rows and 5 variables

Source

Thorne, S., & Kamps, D. (2008). The effects of a group contingency intervention on academic engagement and problem behavior of at-risk students. *Behavior Analysis in Practice, 1*(2), 12-18.

References

Swan, D. M., & Pustejovsky, J. E. (2017). A gradual effects model for single-case designs. http://doi.org/10.17605/OSF.IO/G.

Wright2012	*Wright & McCathren (2012)*

Description

Data from a multiple baseline design conducted by Wright and McCathren (2012), which evaluated the effects of two types of social story interventions (a basic social story and a modified social story) on the behavior of four children with autism. Both dependent variables were measured using frequency counting for 10 minute observation sessions. The variables are as follows:

- Participant Participant identifier.
- Session Session number.
- Condition Phase of the design (baseline, intervention A, or intervention B.
- Problem_behavior Outcome scores.

Format

A data frame with 97 rows and 5 variables

Source

Wright, L. A., & McCathren, R. B. (2012). Utilizing social stories to increase prosocial behavior and reduce problem behavior in young children with autism. *Child Development Research*, 2012, 1-13. doi:10.1155/2012/357291

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