Package 'contentValidity'

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Type Package

Title Content Validity Indices for Instrument Development

Version 0.1.0

Description Computes content validity indices commonly used in instrument development and questionnaire validation, including the Item-level Content Validity Index (I-CVI), Scale-level Content Validity Index (S-CVI), modified kappa adjusted for chance agreement, Aiken's V, and Lawshe's Content Validity Ratio (CVR). Methods follow Lynn (1986) <doi:10.1097/00006199-198611000-00017>, Polit and Beck (2006) <doi:10.1002/nur.20147>, Aiken (1985) <doi:10.1177/0013164485451012>, and Lawshe (1975) <doi:10.1111/j.1744-6570.1975.tb01393.x>.

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Encoding UTF-8

Suggests knitr, rmarkdown, testthat (>= 3.0.0)

VignetteBuilder knitr

Config/testthat/edition 3

URL https://github.com/Rafhq1403/contentValidity

BugReports https://github.com/Rafhq1403/contentValidity/issues

Config/roxygen2/version 8.0.0

Depends R (>= 3.5)

LazyData true

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Contents

`aiken_v` *Aiken's V coefficient of content validity*

Description

Computes Aiken's V (Aiken, 1985), an index of content validity that uses the full rating scale rather than dichotomizing responses as in I-CVI. Aiken's V ranges from 0 to 1, where 1 indicates all experts gave the maximum rating and 0 indicates all gave the minimum.

Usage

```
aiken_v(ratings, lo = 1, hi = 4, na.rm = FALSE)
```

Arguments

`ratings`	A numeric matrix or data frame of expert ratings (rows = experts, columns = items). A numeric vector is also accepted, treated as a single item.
`lo`	Numeric. Minimum possible rating on the scale. Default 1.
`hi`	Numeric. Maximum possible rating on the scale. Default 4.
`na.rm`	Logical. If `TRUE`, missing ratings are excluded. Defaults to `FALSE`.

Details

Aiken's V is calculated as:

$$V = (\bar{X} - lo)/(hi - lo)$$

where $\bar{X}$ is the mean expert rating across raters, and `lo` and `hi` are the minimum and maximum possible scale values, respectively.

A common cutoff is V >= 0.70 for adequate content validity, though stricter thresholds are sometimes applied depending on panel size and research context. Unlike I-CVI, Aiken's V uses the full rating scale, so a rating of 4 contributes more than a rating of 3 (rather than both being counted equally as "relevant").

Value

A named numeric vector of V values, one per item. If `ratings` is a vector, returns a single numeric value.

References

Aiken, L. R. (1985). Three coefficients for analyzing the reliability and validity of ratings. *Educational and Psychological Measurement*, 45(1), 131-142. doi:10.1177/0013164485451012

See Also

`icvi()`

Examples

```
ratings <- matrix(
  c(4, 4, 3, 4, 4,
    3, 4, 4, 4, 3,
    2, 3, 3, 4, 3,
    1, 2, 3, 2, 3),
  nrow = 5,
  dimnames = list(NULL, paste0("item", 1:4))
)
aiken_v(ratings)

# 5-point scale
aiken_v(c(5, 4, 5, 5, 4), lo = 1, hi = 5)
```

---

apa_table *APA-style content validity table*

Description

Generates a publication-ready content validity table following APA conventions, suitable for inclusion in journal manuscripts, theses, and technical reports. Returns a clean data frame by default, with optional rendering to markdown, HTML, or LaTeX via `knitr::kable()`.

Usage

```
apa_table(x, ...)

## S3 method for class 'content_validity'
apa_table(
  x,
  format = c("data.frame", "markdown", "html", "latex", "pipe"),
  digits = 2,
  interpretation = TRUE,
```

```
  caption = NULL,
  ...
)
```

Arguments

x	An object to format. Currently supports objects of class "content_validity" returned by content_validity().
...	Further arguments passed to methods.
format	Output format. One of "data.frame" (default), "markdown", "html", "latex", or "pipe". All formats other than "data.frame" require the knitr package.
digits	Integer. Number of decimal places for numeric values. Default 2 (APA convention for proportions and correlations).
interpretation	Logical. Whether to include an Interpretation column based on modified-kappa cutoffs (Cicchetti & Sparrow, 1981). Default TRUE.
caption	Optional character string. The caption to use when format is not "data.frame". If NULL (default), a standard caption is generated that reports the scale-level indices.

Details

Item-level interpretation labels follow the modified-kappa cutoffs of Cicchetti and Sparrow (1981), as adopted by Polit, Beck, and Owen (2007):

- Excellent: kappa* > 0.74
- Good: kappa* 0.60 to 0.74
- Fair: kappa* 0.40 to 0.59
- Poor: kappa* < 0.40

Scale-level indices are reported in the caption rather than the table body, matching the typical layout used in nursing, education, and health-sciences journals.

Value

A data frame (when format = "data.frame") or a character string suitable for inclusion in an R Markdown document (other formats).

References

Cicchetti, D. V., & Sparrow, S. A. (1981). Developing criteria for establishing interrater reliability of specific items: Applications to assessment of adaptive behavior. *American Journal of Mental Deficiency*, 86(2), 127-137.

Polit, D. F., Beck, C. T., & Owen, S. V. (2007). Is the CVI an acceptable indicator of content validity? Appraisal and recommendations. *Research in Nursing & Health*, 30(4), 459-467. doi:10.1002/nur.20199

Examples

```
data(cvi_example)
result <- content_validity(cvi_example)

# Default: a clean data frame
apa_table(result)

# Markdown for R Markdown documents
if (requireNamespace("knitr", quietly = TRUE)) {
  apa_table(result, format = "markdown")
}
```

`content_validity` *Comprehensive content validity analysis*

Description

Runs the standard relevance-scale content validity indices on a single ratings matrix and returns a tidy summary. Computes Item-level CVI, modified kappa, and Aiken's V at the item level, and S-CVI/Ave, S-CVI/UA, and the mean modified kappa at the scale level.

Usage

```
content_validity(
  ratings,
  relevant_threshold = 3,
  lo = 1,
  hi = 4,
  na.rm = FALSE
)
```

Arguments

`ratings`	A numeric matrix or data frame of expert ratings (rows = experts, columns = items) on a relevance scale.
`relevant_threshold`	Integer. Minimum rating considered "relevant". Passed to `icvi()`, `scvi_ave()`, `scvi_ua()`, and `mod_kappa()`. Defaults to 3.
`lo, hi`	Numeric. Minimum and maximum possible rating values on the scale; passed to `aiken_v()`. Defaults to 1 and 4.
`na.rm`	Logical. Passed to all underlying functions. Defaults to `FALSE`.

Details

Lawshe's CVR is not included in this wrapper because it uses a different rating convention (essential / useful but not essential / not necessary). For CVR analyses, use `cvr()` and `cvr_critical()` directly.

Value

An object of class "content_validity": a list containing

- items: a data frame with one row per item and columns item, icvi, mod_kappa, and aiken_v.
- scale: a named numeric vector with scvi_ave, scvi_ua, and mean_kappa.
- n_experts: integer, number of experts (rows).
- n_items: integer, number of items (columns).

See Also

icvi(), scvi_ave(), scvi_ua(), mod_kappa(), aiken_v(), cvr()

Examples

```
ratings <- matrix(
  c(4, 4, 3, 4, 4,
    3, 4, 4, 4, 3,
    2, 3, 3, 4, 3,
    1, 2, 3, 2, 3),
  nrow = 5,
  dimnames = list(NULL, paste0("item", 1:4))
)
result <- content_validity(ratings)
result
result$items
result$scale
```

---

cvi_example *Example expert ratings for content validity analysis*

Description

A simulated dataset illustrating typical expert ratings during the content validation of a 10-item depression screening instrument. Six expert clinicians rate each item's relevance on a 4-point scale.

Usage

```
cvi_example
```

Format

A 6 by 10 numeric matrix with rows representing expert raters (expert1 through expert6) and columns representing candidate items (item1 through item10). Values are on a 4-point relevance scale:

- 1: not relevant
- 2: somewhat relevant (item needs major revision)
- 3: quite relevant (item needs minor revision)
- 4: highly relevant

Details

The pattern of ratings is realistic: some items achieve universal agreement, most show strong but imperfect agreement, and a couple of items would be flagged for revision based on standard CVI cutoffs (e.g., items 5 and 9 in this example).

Source

Simulated for demonstration; not based on real expert ratings.

Examples

```
data(cvi_example)
icvi(cvi_example)
content_validity(cvi_example)
```

---

cvr *Lawshe's Content Validity Ratio (CVR)*

Description

Computes Lawshe's (1975) Content Validity Ratio for one or more items rated by an expert panel. Each expert classifies an item as "essential", "useful but not essential", or "not necessary"; CVR captures the proportion of experts endorsing "essential" relative to chance.

Usage

```
cvr(ratings, essential = 1, na.rm = FALSE)
```

Arguments

`ratings`	A numeric matrix or data frame of expert ratings (rows = experts, columns = items). A numeric vector is also accepted, treated as a single item.
`essential`	Numeric vector. Rating value(s) that indicate an expert classified the item as "essential". Defaults to 1, matching Lawshe's (1975) original 3-point scale where 1 = essential, 2 = useful but not essential, 3 = not necessary. Pass a vector if multiple values count as essential.
`na.rm`	Logical. If `TRUE`, missing ratings are excluded when counting experts. Defaults to `FALSE`.

Details

The formula is:

$$CVR = (n_e - N/2)/(N/2)$$

where n_e is the number of experts rating the item as essential and N is the total number of experts.

Use `cvr_critical()` to obtain the minimum CVR considered statistically significant for a given panel size, following the corrected critical values of Wilson, Pan, and Schumsky (2012).

Value

A named numeric vector of CVR values per item, ranging from -1 to +1. If `ratings` is a vector, returns a single numeric value.

References

Lawshe, C. H. (1975). A quantitative approach to content validity. *Personnel Psychology*, 28(4), 563-575. doi:10.1111/j.17446570.1975.tb01393.x

Wilson, F. R., Pan, W., & Schumsky, D. A. (2012). Recalculation of the critical values for Lawshe's content validity ratio. *Measurement and Evaluation in Counseling and Development*, 45(3), 197-210. doi:10.1177/0748175612440286

See Also

`cvr_critical()`

Examples

```
# 10 experts rating 3 items on Lawshe's 3-point scale
# (1 = essential, 2 = useful, 3 = not necessary)
ratings <- matrix(
  c(1, 1, 1, 1, 1, 1, 1, 1, 2, 2,    # 8 of 10 essential
    1, 1, 1, 2, 2, 2, 2, 3, 3, 3,    # 3 of 10 essential
    1, 1, 1, 1, 1, 1, 1, 1, 1, 1),   # 10 of 10 essential
  nrow = 10,
  dimnames = list(NULL, paste0("item", 1:3))
)
cvr(ratings)

# Compare to the critical value for N = 10
cvr_critical(10)
```

`cvr_critical` *Critical CVR value for a given panel size*

Description

Returns the minimum Content Validity Ratio considered statistically significant for a panel of N experts at the specified alpha level. The calculation uses the exact binomial distribution under the null hypothesis that each expert independently rates "essential" with probability 0.5, following the corrected approach of Wilson, Pan, and Schumsky (2012).

Usage

```
cvr_critical(n_experts, alpha = 0.05)
```

Arguments

n_experts	Positive integer. Number of experts on the panel.
alpha	Numeric. One-tailed significance level. Defaults to 0.05.

Details

The critical value is determined as the smallest k such that $P(X \geq k) \leq \alpha$ when $X \sim Binomial(N, 0.5)$, then transformed to the CVR scale via $CVR_{crit} = (k - N/2)/(N/2)$.

Wilson, Pan, and Schumsky (2012) demonstrated that Lawshe's (1975) original critical-value table contained errors, especially for small panels. The exact binomial computation used here is their recommended replacement.

Value

Numeric. The critical CVR value. CVR values at or above this threshold are statistically significant. Returns NA_real_ if no CVR value can reach significance at the specified alpha (which can happen for very small panels with stringent alpha).

References

Wilson, F. R., Pan, W., & Schumsky, D. A. (2012). Recalculation of the critical values for Lawshe's content validity ratio. *Measurement and Evaluation in Counseling and Development*, 45(3), 197-210. doi:10.1177/0748175612440286

See Also

cvr()

Examples

```
cvr_critical(10)         # 0.80 — need 9 of 10 experts to call it essential
cvr_critical(20)         # 0.50
cvr_critical(40)         # 0.25
cvr_critical(10, alpha = 0.01)
```

---

icvi *Item-level Content Validity Index (I-CVI)*

Description

Computes the Item-level Content Validity Index (I-CVI) for one or more items rated by a panel of experts on a relevance scale. Following Lynn (1986) and Polit & Beck (2006), I-CVI is calculated as the proportion of experts who rate an item as 3 (relevant) or 4 (highly relevant) on a 4-point relevance scale.

Usage

```
icvi(ratings, relevant_threshold = 3, na.rm = FALSE)
```

Arguments

`ratings`	A numeric matrix or data frame of expert ratings, where rows represent experts and columns represent items. Values are typically on a 1-4 relevance scale. A numeric vector is also accepted, treated as a single item.
`relevant_threshold`	Integer. The minimum rating considered "relevant". Defaults to 3 (i.e., ratings of 3 or 4 count as relevant on a 4-point scale).
`na.rm`	Logical. If `TRUE`, missing ratings are excluded from the calculation. Defaults to `FALSE`, in which case any `NA` produces `NA` for the affected item.

Details

Common interpretation guidelines (Polit & Beck, 2006):

- I-CVI >= 0.78: excellent content validity (with 6 or more experts).
- I-CVI 0.70-0.78: acceptable, item may need revision.
- I-CVI < 0.70: item should be revised or eliminated.

With fewer than six experts, Lynn (1986) recommends a stricter cutoff of I-CVI = 1.00 for unanimous agreement.

Value

A named numeric vector of I-CVI values, one per item. If `ratings` is a vector, returns a single numeric value.

References

Lynn, M. R. (1986). Determination and quantification of content validity. *Nursing Research*, 35(6), 382-385. doi:10.1097/00006199198611000000017

Polit, D. F., & Beck, C. T. (2006). The content validity index: Are you sure you know what's being reported? Critique and recommendations. *Research in Nursing & Health*, 29(5), 489-497. doi:10.1002/nur.20147

Examples

```
# Five experts rating four items on a 1-4 relevance scale
ratings <- matrix(
  c(4, 4, 3, 4, 4,    # Item 1
    3, 4, 4, 4, 3,    # Item 2
    2, 3, 3, 4, 3,    # Item 3
    1, 2, 3, 2, 3),   # Item 4
  nrow = 5,
  dimnames = list(NULL, paste0("item", 1:4))
)
```

```
icvi(ratings)

# Single item supplied as a vector
icvi(c(4, 4, 3, 3, 4))

# Stricter threshold (only highest rating counts as relevant)
icvi(ratings, relevant_threshold = 4)
```

---

mod_kappa *Modified kappa - I-CVI adjusted for chance agreement*

Description

Computes modified kappa for each item, as proposed by Polit, Beck, and Owen (2007). Modified kappa adjusts the Item-level Content Validity Index (I-CVI) for chance agreement under the assumption that each expert independently rates an item as relevant with probability 0.5.

Usage

```
mod_kappa(ratings, relevant_threshold = 3, na.rm = FALSE)
```

Arguments

ratings	A numeric matrix or data frame of expert ratings (rows = experts, columns = items). A numeric vector is also accepted, treated as a single item.
relevant_threshold	Integer. Minimum rating considered "relevant". Defaults to 3.
na.rm	Logical. If TRUE, missing ratings are excluded when counting experts and agreements. Defaults to FALSE.

Details

The formula is:

$$\kappa^* = (\text{I-CVI} - P_c)/(1 - P_c)$$

where the chance agreement probability is

$$P_c = \binom{N}{A} \times 0.5^N$$

with N = number of experts and A = number of experts rating the item as relevant.

Common interpretation cutoffs (Cicchetti and Sparrow, 1981; adopted by Polit et al., 2007):

- kappa* < 0.40: poor
- kappa* 0.40-0.59: fair
- kappa* 0.60-0.74: good
- kappa* > 0.74: excellent

Value

A named numeric vector of modified-kappa values, one per item. If `ratings` is a vector, returns a single numeric value.

References

Cicchetti, D. V., & Sparrow, S. A. (1981). Developing criteria for establishing interrater reliability of specific items: Applications to assessment of adaptive behavior. *American Journal of Mental Deficiency*, 86(2), 127-137.

Polit, D. F., Beck, C. T., & Owen, S. V. (2007). Is the CVI an acceptable indicator of content validity? Appraisal and recommendations. *Research in Nursing & Health*, 30(4), 459-467. doi:10.1002/nur.20199

See Also

`icvi()`

Examples

```
ratings <- matrix(
  c(4, 4, 3, 4, 4,
    3, 4, 4, 4, 3,
    2, 3, 3, 4, 3,
    1, 2, 3, 2, 3),
  nrow = 5,
  dimnames = list(NULL, paste0("item", 1:4))
)
mod_kappa(ratings)
```

---

print.content_validity

Print method for content_validity objects

Description

Print method for content_validity objects

Usage

```
## S3 method for class 'content_validity'
print(x, digits = 4, ...)
```

Arguments

`x`	A `content_validity` object returned by `content_validity()`.
`digits`	Integer. Number of digits to round numeric output to.
`...`	Currently ignored.

Value

Invisibly returns `x`.

`scvi_ave` *Scale-level Content Validity Index, Average method (S-CVI/Ave)*

Description

Computes the Scale-level Content Validity Index using the averaging method, defined as the mean of the Item-level Content Validity Indices (I-CVI) across all items in the instrument.

Usage

```
scvi_ave(ratings, relevant_threshold = 3, na.rm = FALSE)
```

Arguments

`ratings`	A numeric matrix or data frame of expert ratings (rows = experts, columns = items) on a relevance scale.
`relevant_threshold`	Integer. Minimum rating considered "relevant". Defaults to 3.
`na.rm`	Logical. Passed through to `icvi()`. Defaults to `FALSE`.

Details

S-CVI/Ave >= 0.90 is generally considered excellent content validity at the scale level (Polit & Beck, 2006). Note that S-CVI is undefined for a single item; supply a matrix or data frame with two or more item columns.

Value

A single numeric value: the average I-CVI across items.

References

Polit, D. F., & Beck, C. T. (2006). The content validity index: Are you sure you know what's being reported? Critique and recommendations. *Research in Nursing & Health*, 29(5), 489-497. doi:10.1002/nur.20147

See Also

`icvi()`

Examples

```
ratings <- matrix(
  c(4, 4, 3, 4, 4,
    3, 4, 4, 4, 3,
    2, 3, 3, 4, 3,
    1, 2, 3, 2, 3),
  nrow = 5
)
scvi_ave(ratings)
```

`scvi_ua` *Scale-level Content Validity Index, Universal Agreement method (S-CVI/UA)*

Description

Computes the Scale-level Content Validity Index using the universal agreement method, defined as the proportion of items where all experts rate the item as relevant.

Usage

```
scvi_ua(ratings, relevant_threshold = 3, na.rm = FALSE)
```

Arguments

`ratings`	A numeric matrix or data frame of expert ratings (rows = experts, columns = items) on a relevance scale.
`relevant_threshold`	Integer. Minimum rating considered "relevant". Defaults to 3.
`na.rm`	Logical. If `TRUE`, missing ratings are ignored when checking universal agreement. Defaults to `FALSE`.

Details

S-CVI/UA is a stricter criterion than S-CVI/Ave and tends to produce lower values, especially with larger expert panels. Polit and Beck (2006) recommend reporting both indices together. With small panels of 3-5 experts, S-CVI/UA >= 0.80 is often considered acceptable.

Value

A single numeric value: the proportion of items with universal agreement.

References

Polit, D. F., & Beck, C. T. (2006). The content validity index: Are you sure you know what's being reported? Critique and recommendations. *Research in Nursing & Health*, 29(5), 489-497. doi:10.1002/nur.20147

See Also

icvi(), scvi_ave()

Examples

```
ratings <- matrix(
  c(4, 4, 3, 4, 4,
    3, 4, 4, 4, 3,
    2, 3, 3, 4, 3,
    1, 2, 3, 2, 3),
  nrow = 5
)
scvi_ua(ratings)
```

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