Package: Romney (via r-universe)

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Type Package

Title Classical Cultural Consensus Analysis

Version 0.1.1

Description Implements classical cultural consensus analysis with formal, informal, and covariance agreement models, 'UCINET'-aligned minimum-residual factor extraction, competence estimation, and answer-key estimation. Based on the classical framework of Romney, Weller, and Batchelder (1986) <doi:10.1525/aa.1986.88.2.02a00020>, Romney, Batchelder, and Weller (1987) <doi:10.1177/000276487031002003>, and Weller (2007) <doi:10.1177/1525822X07303502>.

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Contents

agreement_models 2
answerkey_covariance 3
answerkey_formal 4
answerkey_informal 5
consensus 6
simulate_consensus_data 7

Index **9**

`agreement_models` *Agreement matrices for consensus analysis*

Description

Compute respondent-by-respondent agreement matrices for the formal, informal, and covariance consensus models.

Usage

```
agreement_formal(data, n_answers = NULL)

agreement_informal(data)

agreement_covariance(data, prior = 0.5, answer_levels = NULL)
```

Arguments

`data`	A respondent-by-item matrix or data frame.
`n_answers`	Number of possible answers for the formal model, including options that were not observed. All items must have the same options.
`prior`	Prior proportion of true items for the covariance model.
`answer_levels`	Optional vector of the two allowable binary responses.

Details

Missing responses are excluded pairwise, not imputed. Formal agreement is $(mp_{ij} - 1)/(m - 1)$, where p_{ij} is the proportion of matching responses and m is the number of choices. Informal agreement uses Pearson correlations of respondent profiles. Numeric rank codes are treated as scores; arbitrary ordinal recoding is not invariant under Pearson correlation. Covariance agreement divides the sample covariance of binary profiles by $\pi(1 - \pi)$. The second allowed response value (by default the higher sorted value) is treated as true. Diagonals are set to one as input to factor extraction; they are not estimates of competence.

Value

A square agreement matrix.

References

Romney, A. K., Weller, S. C., and Batchelder, W. H. (1986). Culture as consensus: A theory of culture and informant accuracy. American Anthropologist, 88(2), 313–338. doi:10.1525/aa.1986.88.2.02a00020.
Weller, S. C. (2007). Cultural consensus theory: Applications and frequently asked questions. Field Methods, 19(4), 339–368. doi:10.1177/1525822X07303502.

Examples

```
x <- rbind(c(0, 1, 1, 0), c(0, 1, 0, 0), c(1, 1, 1, 0))
agreement_formal(x, n_answers = 2)
agreement_covariance(x)
```

`answerkey_covariance` *Estimate a binary competence-weighted answer key*

Description

Estimate a binary competence-weighted answer key

Usage

```
answerkey_covariance(data, competence, answer_levels = NULL)
```

Arguments

`data`	A respondent-by-item matrix or data frame with two response values.
`competence`	Finite competence scores in $[0, 1]$, one per respondent.
`answer_levels`	Optional vector specifying the two allowable responses.

Details

Each observed response contributes its respondent's competence to the corresponding category. The category with the greater total weight is selected. Missing responses are omitted, and weights are normalized within each item. Ties within 10^{-12}, entirely missing items, and items with zero total weight have `NA` keys. This is a weighted vote, not a posterior probability calculation or an estimate of respondent response bias.

Value

A list with `key`, `levels`, `status`, `weighted_proportions`, and `weighted_frequencies`. Frequencies are proportions multiplied by the total number of respondents, as in 'UCINET' detail tables. Status may also be `zero_weight`.

References

Weller, S. C. (2007). Cultural consensus theory: Applications and frequently asked questions. Field Methods, 19(4), 339–368. doi:10.1177/1525822X07303502.

Examples

```
answerkey_covariance(matrix(c(0, 1, 1), ncol = 1), c(0.2, 0.8, 0.7))
```

`answerkey_formal` *Estimate a formal consensus answer key*

Description

Estimate a formal consensus answer key

Usage

```
answerkey_formal(data, competence, prior = NULL, answer_levels = NULL)
```

Arguments

`data`	A respondent-by-item matrix or data frame.
`competence`	Numeric competence scores, one per respondent.
`prior`	Optional prior distribution over answer levels. Can be `NULL`, a vector of answer-level priors, or a matrix with one column per item.
`answer_levels`	Optional ordered vector of allowable answer levels.

Details

For candidate answer k, a matching response has likelihood $c_i + (1 - c_i)/m$; each specific non-matching response has likelihood $(1 - c_i)/m$. Posterior probabilities condition on the supplied competence estimates; they do not include uncertainty in those estimates. Computation uses log likelihoods. Ties within 10^{-12}, entirely missing items, and impossible observations have `NA` answer keys. Missing items retain their prior distribution. If every candidate has zero likelihood, probabilities are `NA` and a warning is issued. Weighted frequencies are separate descriptive quantities, not posteriors.

Value

A list with `key`, `probabilities`, `levels`, `status`, normalized `prior`, `weighted_proportions`, and `weighted_frequencies`. Status is `estimated`, `tie`, `no_data`, or `impossible`. Weighted frequencies are proportions multiplied by the total number of respondents, matching the scale of 'UCINET' detail tables.

References

Romney, A. K., Weller, S. C., and Batchelder, W. H. (1986). Culture as consensus: A theory of culture and informant accuracy. American Anthropologist, 88(2), 313–338. doi:10.1525/aa.1986.88.2.02a00020.

Examples

```
x <- matrix(c("A", "A", "B"), ncol = 1)
answerkey_formal(x, c(0.8, 0.7, 0.2), answer_levels = LETTERS[1:4])
```

`answerkey_informal` *Estimate an informal competence-weighted answer key*

Description

Estimate an informal competence-weighted answer key

Usage

```
answerkey_informal(data, competence)
```

Arguments

`data`	A numeric respondent-by-item matrix or data frame.
`competence`	Finite signed factor loadings, one per respondent.

Details

Returns $\sum_i c_i x_{ij} / \sum_i c_i$ over observed responses to each item. Signed weights are retained. A non-positive total weight or an entirely missing item produces an `NA` key. Negative weights can yield means outside the observed response range and warrant scrutiny of the single-culture assumption. These means are in the original response units; they are not standardized regression factor scores or posterior probabilities. Agreement uses Pearson correlations, so numeric coding of ordinal responses affects the analysis.

Value

A list with numeric `key`, `status`, and `weight_sum`.

References

Romney, A. K., Batchelder, W. H., and Weller, S. C. (1987). Recent applications of cultural consensus theory. American Behavioral Scientist, 31(2), 163–177. doi:10.1177/000276487031002003.

Examples

```
answerkey_informal(rbind(c(1, 4), c(2, 5)), c(0.8, 0.4))
```

consensus *Run a cultural consensus analysis*

Description

Run a cultural consensus analysis

Usage

```
consensus(
  data,
  cultures = 1,
  method = c("formal", "informal", "covariance"),
  prior = 0.5,
  return_answer_key = TRUE,
  n_answers = NULL,
  answer_levels = NULL,
  competence_policy = c("strict", "truncate")
)
```

Arguments

`data`	A respondent-by-item matrix or data frame.
`cultures`	Number of factor dimensions to return. Additional dimensions are not automatically distinct cultural groups.
`method`	One of `"formal"`, `"informal"`, or `"covariance"`.
`prior`	Prior proportion of true items for the covariance model.
`return_answer_key`	Whether to estimate a first-factor answer key.
`n_answers`	Optional number of possible responses for the formal model.
`answer_levels`	Optional vector specifying all categorical response options, including unobserved options. Not used for the informal model.
`competence_policy`	Policy for formal and covariance answer keys when first-factor loadings are outside $[0, 1]$. `"strict"` (default) skips the key with a warning; `"truncate"` explicitly clips only answer-key weights. Reported competence and diagnostics always retain signed loadings.

Details

Analysis requires at least three respondents and two items. At least two unrotated minimum-residual factors are extracted for the first-to-second factor ratio, even when only the first is returned. Extraction failures are errors, not substitutions of another estimator. The legacy `eigenvalues` field contains factor sums of squared loadings; `raw_eigenvalues` contains eigenvalues of the input agreement matrix. These are different quantities. Warnings and residuals are retained in `diagnostics`;

convergence is not certified by a large ratio. The ratio of three is a heuristic, not a statistical significance test. The mean-competence threshold is not applied to the informal model, whose loadings are not probabilities of knowing an answer.

Value

An object of class `romney_consensus` containing:

- `agreement`: respondent-by-respondent agreement matrix.
- `loadings`, `competence`: signed loadings for returned factors.
- `factor_ss_loadings`, `eigenvalues`: factor sums of squares.
- `raw_eigenvalues`: eigenvalues of the input agreement matrix.
- `ratio_eigen_1_2`, `mean_competence`, `criteria`: descriptive diagnostics, not significance tests.
- `answer_key`: model-specific key and item statuses, or NULL when not requested or invalid under the selected competence policy.
- `answer_key_weights`: weights actually used for that key.
- `diagnostics`: extraction warnings, communalities, residuals, overlap counts, factor-library version and answer-key status.

References

Romney, A. K., Weller, S. C., and Batchelder, W. H. (1986). Culture as consensus: A theory of culture and informant accuracy. American Anthropologist, 88(2), 313–338. doi:10.1525/aa.1986.88.2.02a00020.
Romney, A. K., Batchelder, W. H., and Weller, S. C. (1987). Recent applications of cultural consensus theory. American Behavioral Scientist, 31(2), 163–177. doi:10.1177/000276487031002003.
Weller, S. C. (2007). Cultural consensus theory: Applications and frequently asked questions. Field Methods, 19(4), 339–368. doi:10.1177/1525822X07303502.

Examples

```
x <- simulate_consensus_data(24, 60, n_answers = 4, competence = 0.6, seed = 7)
fit <- consensus(x$responses, answer_levels = 1:4)
fit$mean_competence
head(fit$answer_key$key)
```

`simulate_consensus_data`

Simulate formal consensus data

Description

Simulate formal consensus data

Usage

```
simulate_consensus_data(
  n_respondents,
  n_questions,
  n_answers = 2,
  competence = 0.7,
  seed = NULL
)
```

Arguments

`n_respondents`	Number of respondents.
`n_questions`	Number of questions/items.
`n_answers`	Number of possible answers per item.
`competence`	Scalar or vector of respondent competences.
`seed`	Optional non-negative integer seed. With a seed, the caller's random-number state is restored on exit.

Details

Respondent i knows an answer with probability c_i. Otherwise the respondent guesses uniformly among all m options, including the correct one. Thus the probability of a correct response is $c_i + (1-c_i)/m$, not c_i. Responses are conditionally independent given the answer key and competences. All items have the same choices and there is no response bias or missingness.

Value

A list with `responses`, `key`, and `competence`.

References

Romney, A. K., Weller, S. C., and Batchelder, W. H. (1986). Culture as consensus: A theory of culture and informant accuracy. American Anthropologist, 88(2), 313–338. doi:10.1525/aa.1986.88.2.02a00020.

Examples

```
simulated <- simulate_consensus_data(12, 30, n_answers = 4, seed = 42)
dim(simulated$responses)
```

Index

agreement_covariance
(agreement_models), 2
agreement_formal (agreement_models), 2
agreement_informal (agreement_models), 2
agreement_models, 2
answerkey_covariance, 3
answerkey_formal, 4
answerkey_informal, 5

consensus, 6

simulate_consensus_data, 7