

Package ‘spheredata’

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Title Students' Performance Dataset in Physics Education Research
(SPHERE)

Version 0.1.3

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Description A multidimensional dataset of students' performance assessment in high school physics. The SPHERE dataset was collected from 497 students in four public high schools specifically measuring their conceptual understanding, scientific ability, and attitude toward physics [see Santoso et al. (2024) <[doi:10.17632/88d7m2fv7p.1](https://doi.org/10.17632/88d7m2fv7p.1)>]. The data collection was conducted using some research based assessments established by the physics education research community. They include the Force Concept Inventory, the Force and Motion Conceptual Evaluation, the Rotational and Rolling Motion Conceptual Survey, the Fluid Mechanics Concept Inventory, the Mechanical Waves Conceptual Survey, the Thermal Concept Evaluation, the Survey of Thermodynamic Processes and First and Second Laws, the Scientific Abilities Assessment Rubrics, and the Colorado Learning Attitudes about Science Survey. Students' attributes related to gender, age, socioeconomic status, domicile, literacy, physics identity, and test results administered using teachers' developed items are also reported in this dataset.

BugReports <https://github.com/santosoph/spheredata/issues>

URL <https://github.com/santosoph/spheredata>

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aikenV

Compute the Aiken's V index of content validity

Description

Aiken's V is a statistical measure of content validity index on a single item (Aiken, 1980). This measure could be defined as follow.

$$V = \frac{\bar{X} - l}{k}$$

where \bar{X} represents the sample mean of the judges' ratings, l represents the lowest possible rating, and k represents the range of possible values of the rating scale used (e.g., a scale having possible

values extending from 1 to 5 has $l = 1$ and $k = 5 - 1 = 4$). Then, Penfield and Giacobbi (2004) suggest a method to compute the confidence interval of Aiken's V index using the formula below.

$$L = \frac{2nkV + z^2 - z\sqrt{4nkV(1-V) + z^2}}{2(nk + z^2)}$$

$$U = \frac{2nkV + z^2 + z\sqrt{4nkV(1-V) + z^2}}{2(nk + z^2)}$$

where L and U are the lower and upper limit of Aiken's V index within a $C\%$ confidence interval, and the z is a critical value of a standard normal distribution such that $C\%$ of the area of the distribution lies between $-z$ and z (e.g., for a 95% confidence interval $z = 1.96$).

Usage

```
aikenV(data, max_cat = 4, min_cat = 1, CI = 0.95)
```

Arguments

data	a dataframe of categorical value from expert judgment to the item content validity.
max_cat	a maximum category point of used rating scale (the default value is 4).
min_cat	a minimum category point of used rating scale (the default value is 1).
CI	the default value of confidence interval is 0.95. It can be set to preferred confidence interval.

Value

a dataframe of content validity index of each item as calculated using the Aiken's formula

References

Aiken, L.R. Content Validity and Reliability of Single Items or Questionnaires. *Educational and Psychological Measurement* 40, 955-959 (1980).

Penfield, R.D. & Giacobbi, P.R. Applying a Score Confidence Interval to Aiken's Item Content-Relevance Index. *Measurement in Physical Education and Exercise Science* 8, 4, 213-225 (2004).

Examples

```
# In this example, we define a dataframe describing the rating of ten
# imaginary items as assessed by seven artificial experts. The minimum point
# of the rating scale is 1, and the maximum point that could be given by
# those experts is 4.
```

```
df <- data.frame(item1 = c(3,3,3,4,4,4,3),
                 item2 = c(2,4,3,2,4,4,4),
                 item3 = c(4,3,3,2,4,4,3),
                 item4 = c(3,2,3,3,4,3,3),
                 item5 = c(4,4,4,3,3,3,3),
                 item6 = c(3,3,3,4,3,3,4),
```

```
item7 = c(4,4,4,3,4,4,4),
item8 = c(3,3,4,4,4,4,4),
item9 = c(4,4,4,3,4,4,4),
item10 = c(4,3,4,4,3,3,4))

# Compute the Aiken's V
aikenV(df)
```

binary

Compute the students' score of spheredata package

Description

Compute the students' score as binary/ dichotomous value. The calculation method is based on a classical test theory perspective.

Usage

```
binary(raw, key)
```

Arguments

raw	a dataframe of raw response data
key	a dataframe of answer key

Value

a dataframe of dichotomous format of students' response data

Examples

```
# Import the FCI score and key data
library(spheredata)
data("FCI")
data("FCIkey")

# Processing the Force Concept Inventory (FCI) data as dichotomous
binary(FCI, FCIkey)
```

CLASS	<i>The Colorado Learning Attitudes about Science Survey (CLASS) dataset</i>
-------	---

Description

The CLASS originally includes 42 attitudinal items measuring students' attitude toward physics learning within five categories of Likert scale ranging from strongly disagree (1) to strongly agree (5). In this package, thirty-six CLASS items have been preprocessed based on the scoring rule as suggested by Adams et al. (2006).

Usage

```
data(CLASS)
```

Format

A data frame of students' responses on the following 36 CLASS items (after preprocessed using the scoring rule).

CLASS1 A student's response on the CLASS item number 1.
CLASS2 A student's response on the CLASS item number 2.
CLASS3 A student's response on the CLASS item number 3.
CLASS5 A student's response on the CLASS item number 5.
CLASS6 A student's response on the CLASS item number 6.
CLASS8 A student's response on the CLASS item number 8.
CLASS10 A student's response on the CLASS item number 10.
CLASS11 A student's response on the CLASS item number 11.
CLASS12 A student's response on the CLASS item number 12.
CLASS13 A student's response on the CLASS item number 13.
CLASS14 A student's response on the CLASS item number 14.
CLASS15 A student's response on the CLASS item number 15.
CLASS16 A student's response on the CLASS item number 16.
CLASS17 A student's response on the CLASS item number 17.
CLASS18 A student's response on the CLASS item number 18.
CLASS19 A student's response on the CLASS item number 19.
CLASS20 A student's response on the CLASS item number 20.
CLASS21 A student's response on the CLASS item number 21.
CLASS22 A student's response on the CLASS item number 22.
CLASS23 A student's response on the CLASS item number 23.
CLASS24 A student's response on the CLASS item number 24.

CLASS25 A student's response on the CLASS item number 25.
CLASS26 A student's response on the CLASS item number 26.
CLASS27 A student's response on the CLASS item number 27.
CLASS28 A student's response on the CLASS item number 28.
CLASS29 A student's response on the CLASS item number 29.
CLASS30 A student's response on the CLASS item number 30.
CLASS32 A student's response on the CLASS item number 32.
CLASS34 A student's response on the CLASS item number 34.
CLASS35 A student's response on the CLASS item number 35.
CLASS36 A student's response on the CLASS item number 36.
CLASS37 A student's response on the CLASS item number 37.
CLASS38 A student's response on the CLASS item number 38.
CLASS39 A student's response on the CLASS item number 39.
CLASS40 A student's response on the CLASS item number 40.
CLASS42 A student's response on the CLASS item number 42.

Source

Santoso, P. H. et al. SPHERE: Students' performance dataset of conceptual understanding, scientific ability, and learning attitude in physics education research (PER). *Mendeley Data, VI*, (2024). doi: 10.17632/88d7m2fv7p.1

References

Adams, W. K. et al. New instrument for measuring student beliefs about physics and learning physics: The Colorado Learning Attitudes about Science Survey. *Physical Review Special Topics - Physics Education Research* 2, 010101 (2006).

Examples

```
library(spheredata)
# Call the data from spheredata package
get("CLASS")
# Open the data
CLASS
```

CLASScontentvalidity *The Colorado Learning Attitudes about Science Survey (CLASS) content validity dataset*

Description

In this data, five PER experts rated the content validity of the CLASS.

Usage

```
data(CLASScontentvalidity)
```

Format

A data frame of expert ratings on the content validity of 36 CLASS items (after preprocessed using the scoring rule).

ID An anonymized expert identity.

CLASS1 A numeric of expert rating to the CLASS item 1.

CLASS2 A numeric of expert rating to the CLASS item 2.

CLASS3 A numeric of expert rating to the CLASS item 3.

CLASS5 A numeric of expert rating to the CLASS item 5.

CLASS6 A numeric of expert rating to the CLASS item 6.

CLASS8 A numeric of expert rating to the CLASS item 8.

CLASS10 A numeric of expert rating to the CLASS item 10.

CLASS11 A numeric of expert rating to the CLASS item 11.

CLASS12 A numeric of expert rating to the CLASS item 12.

CLASS13 A numeric of expert rating to the CLASS item 13.

CLASS14 A numeric of expert rating to the CLASS item 14.

CLASS15 A numeric of expert rating to the CLASS item 15.

CLASS16 A numeric of expert rating to the CLASS item 16.

CLASS17 A numeric of expert rating to the CLASS item 17.

CLASS18 A numeric of expert rating to the CLASS item 18.

CLASS19 A numeric of expert rating to the CLASS item 19.

CLASS20 A numeric of expert rating to the CLASS item 20.

CLASS21 A numeric of expert rating to the CLASS item 21.

CLASS22 A numeric of expert rating to the CLASS item 22.

CLASS23 A numeric of expert rating to the CLASS item 23.

CLASS24 A numeric of expert rating to the CLASS item 24.

CLASS25 A numeric of expert rating to the CLASS item 25.

CLASS26 A numeric of expert rating to the CLASS item 26.
 CLASS27 A numeric of expert rating to the CLASS item 27.
 CLASS28 A numeric of expert rating to the CLASS item 28.
 CLASS29 A numeric of expert rating to the CLASS item 29.
 CLASS30 A numeric of expert rating to the CLASS item 30.
 CLASS32 A numeric of expert rating to the CLASS item 32.
 CLASS34 A numeric of expert rating to the CLASS item 34.
 CLASS35 A numeric of expert rating to the CLASS item 35.
 CLASS36 A numeric of expert rating to the CLASS item 36.
 CLASS37 A numeric of expert rating to the CLASS item 37.
 CLASS38 A numeric of expert rating to the CLASS item 38.
 CLASS39 A numeric of expert rating to the CLASS item 39.
 CLASS40 A numeric of expert rating to the CLASS item 40.
 CLASS42 A numeric of expert rating to the CLASS item 42.

Examples

```
library(spheredata)
# Call the data from spheredata package
get("CLASScontentvalidity")
# Open the data
CLASScontentvalidity
```

demographic

Students' demographic of the SPHERE dataset

Description

This dataset is used to describe the students' contexts of this study.

Usage

```
data(demographic)
```

Format

A data frame with 497 observations on the following 8 demographic variables.

STUDID Students' identity. The first letter denotes the school code. The second one coins the students' cohort within schools. Three last numbers for their alphabetical orders.

SCH School sample participated in the study.

COH Students' class within schools. 1 = Group A, 2 = Group B, 3 = Group C, 4 = Group D

GDR Students' gender. 1 = Male, 2 = Female

- AGE Students' age. 1 = 13-14 years, 2 = 15-16 years, 3 = 17-18 years, 4 = 19-20 years
- FATHOCC Father's occupation. 1 = Entrepreneur, 2 = Farmer, 3 = Armed force, 4 = Private employee, 5 = Educator, 6 = Medicine, 7 = Civil servant, 8 = Unemployed, 9 = Others
- MOTHOCC Mother's occupation. 1 = Entrepreneur, 2 = Farmer, 3 = Armed force, 4 = Private employee, 5 = Educator, 6 = Medicine, 7 = Civil servant, 8 = Unemployed, 9 = Others
- FATHEDU Father's education. 1 = Graduate, 2 = Undergraduate, 3 = Vocational, 4 = High school, 5 = Junior high school, 6 = Elementary, 7 = Unfinished education, 8 = Out of formal education
- MOTHEDEU Mother's education. 1 = Graduate, 2 = Undergraduate, 3 = Vocational, 4 = High school, 5 = Junior high school, 6 = Elementary, 7 = Unfinished education, 8 = Out of formal education
- FATHINC Father's monthly income. 1 = More than IDR10.000.000, 2 = IDR9.000.000-IDR10.000.000, 3 = IDR8.000.000-IDR9.000.000, 4 = IDR7.000.000-IDR8.000.000, 5 = IDR6.000.000-IDR7.000.000, 6 = IDR5.000.000-IDR6.000.000, 7 = IDR4.000.000-IDR5.000.000, 8 = IDR3.000.000-IDR4.000.000, 9 = IDR2.000.000-IDR3.000.000, 10 = IDR1.000.000-IDR2.000.000, 11 = Less than IDR1.000.000, 12 = No income
- MOTHINC Mother's monthly income. 1 = More than IDR10.000.000, 2 = IDR9.000.000-IDR10.000.000, 3 = IDR8.000.000-IDR9.000.000, 4 = IDR7.000.000-IDR8.000.000, 5 = IDR6.000.000-IDR7.000.000, 6 = IDR5.000.000-IDR6.000.000, 7 = IDR4.000.000-IDR5.000.000, 8 = IDR3.000.000-IDR4.000.000, 9 = IDR2.000.000-IDR3.000.000, 10 = IDR1.000.000-IDR2.000.000, 11 = Less than IDR1.000.000, 12 = No income
- SIBL Number of siblings belonged to the student. Zero means student as an only child.
- DOM Student's domicile from the school location. 1 = Inside the zoning area of the school. 2 = Outside the zoning area of the school.

Source

Santoso, P. H. et al. SPHERE: Students' performance dataset of conceptual understanding, scientific ability, and learning attitude in physics education research (PER). *Mendeley Data, VI*, (2024). doi: 10.17632/88d7m2fv7p.1

Examples

```
library(spheredata)
# Call the data from spheredata package
get("demographic")
# Open the data
demographic
```

FCI

The Force Concept Inventory (FCI) dataset

Description

The focus of the FCI is intended to measure students' conceptual understanding of Newtonian mechanics. It comprises of 30 multiple-choice items with five possible responses (a key and four distractors).

Usage

```
data(FCI)
```

Format

A data frame of students' responses on the following 30 FCI multiple choice items.

FCI1 A student's response on the FCI item number 1.

FCI2 A student's response on the FCI item number 2.

FCI3 A student's response on the FCI item number 3.

FCI4 A student's response on the FCI item number 4.

FCI5 A student's response on the FCI item number 5.

FCI6 A student's response on the FCI item number 6.

FCI7 A student's response on the FCI item number 7.

FCI8 A student's response on the FCI item number 8.

FCI9 A student's response on the FCI item number 9.

FCI10 A student's response on the FCI item number 10.

FCI11 A student's response on the FCI item number 11.

FCI12 A student's response on the FCI item number 12.

FCI13 A student's response on the FCI item number 13.

FCI14 A student's response on the FCI item number 14.

FCI15 A student's response on the FCI item number 15.

FCI16 A student's response on the FCI item number 16.

FCI17 A student's response on the FCI item number 17.

FCI18 A student's response on the FCI item number 18.

FCI19 A student's response on the FCI item number 19.

FCI20 A student's response on the FCI item number 20.

FCI21 A student's response on the FCI item number 21.

FCI22 A student's response on the FCI item number 22.

FCI23 A student's response on the FCI item number 23.

FCI24 A student's response on the FCI item number 24.

FCI25 A student's response on the FCI item number 25.

FCI26 A student's response on the FCI item number 26.

FCI27 A student's response on the FCI item number 27.

FCI28 A student's response on the FCI item number 28.

FCI29 A student's response on the FCI item number 29.

FCI30 A student's response on the FCI item number 30.

Source

Santoso, P. H. et al. SPHERE: Students' performance dataset of conceptual understanding, scientific ability, and learning attitude in physics education research (PER). *Mendeley Data*, VI, (2024). doi: 10.17632/88d7m2fv7p.1.

References

Hestenes, D., Wells, M. & Swackhamer, G. Force concept inventory. *Phys Teach* 30, 141–158 (1992).

Examples

```
library(spheredata)
# Call the data from spheredata package
get("FCI")
# Open the data
FCI
```

FCIcontentvalidity *The Force Concept Inventory (FCI) content validity dataset*

Description

In this data, five PER experts rated the content validity of the FCI.

Usage

```
data(FCIcontentvalidity)
```

Format

A data frame of expert ratings on the content validity of 30 FCI items.

ID An anonymized expert identity.

FCI1 A numeric value of expert rating to the FCI item number 1.

FCI2 A numeric value of expert rating to the FCI item number 2.

FCI3 A numeric value of expert rating to the FCI item number 3.

FCI4 A numeric value of expert rating to the FCI item number 4.

FCI5 A numeric value of expert rating to the FCI item number 5.

FCI6 A numeric value of expert rating to the FCI item number 6.

FCI7 A numeric value of expert rating to the FCI item number 7.

FCI8 A numeric value of expert rating to the FCI item number 8.

FCI9 A numeric value of expert rating to the FCI item number 9.

FCI10 A numeric value of expert rating to the FCI item number 10.

FCI11 A numeric value of expert rating to the FCI item number 11.
FCI12 A numeric value of expert rating to the FCI item number 12.
FCI13 A numeric value of expert rating to the FCI item number 13.
FCI14 A numeric value of expert rating to the FCI item number 14.
FCI15 A numeric value of expert rating to the FCI item number 15.
FCI16 A numeric value of expert rating to the FCI item number 16.
FCI17 A numeric value of expert rating to the FCI item number 17.
FCI18 A numeric value of expert rating to the FCI item number 18.
FCI19 A numeric value of expert rating to the FCI item number 19.
FCI20 A numeric value of expert rating to the FCI item number 20.
FCI21 A numeric value of expert rating to the FCI item number 21.
FCI22 A numeric value of expert rating to the FCI item number 22.
FCI23 A numeric value of expert rating to the FCI item number 23.
FCI24 A numeric value of expert rating to the FCI item number 24.
FCI25 A numeric value of expert rating to the FCI item number 25.
FCI26 A numeric value of expert rating to the FCI item number 26.
FCI27 A numeric value of expert rating to the FCI item number 27.
FCI28 A numeric value of expert rating to the FCI item number 28.
FCI29 A numeric value of expert rating to the FCI item number 29.
FCI30 A numeric value of expert rating to the FCI item number 30.

Examples

```
library(spheredata)
# Call the data from spheredata package
get("FCIcontentvalidity")
# Open the data
FCIcontentvalidity
```

FCIkey

The Force Concept Inventory (FCI) key dataset

Description

The answers key to analyze the students' obtained score on the FCI.

Usage

```
data(FCIkey)
```

Format

A data frame of answer keys on the following 30 FCI items.

- FCI1 A key of the FCI item number 1.
- FCI2 A key of the FCI item number 2.
- FCI3 A key of the FCI item number 3.
- FCI4 A key of the FCI item number 4.
- FCI5 A key of the FCI item number 5.
- FCI6 A key of the FCI item number 6.
- FCI7 A key of the FCI item number 7.
- FCI8 A key of the FCI item number 8.
- FCI9 A key of the FCI item number 9.
- FCI10 A key of the FCI item number 10.
- FCI11 A key of the FCI item number 11.
- FCI12 A key of the FCI item number 12.
- FCI13 A key of the FCI item number 13.
- FCI14 A key of the FCI item number 14.
- FCI15 A key of the FCI item number 15.
- FCI16 A key of the FCI item number 16.
- FCI17 A key of the FCI item number 17.
- FCI18 A key of the FCI item number 18.
- FCI19 A key of the FCI item number 19.
- FCI20 A key of the FCI item number 20.
- FCI21 A key of the FCI item number 21.
- FCI22 A key of the FCI item number 22.
- FCI23 A key of the FCI item number 23.
- FCI24 A key of the FCI item number 24.
- FCI25 A key of the FCI item number 25.
- FCI26 A key of the FCI item number 26.
- FCI27 A key of the FCI item number 27.
- FCI28 A key of the FCI item number 28.
- FCI29 A key of the FCI item number 29.
- FCI30 A key of the FCI item number 30.

Examples

```
library(spheredata)
# Call the data from spheredata package
get("FCIkey")
# Open the data
FCIkey
```

FMCE

The Force and Motion Conceptual Evaluation (FMCE) dataset

Description

Similar with the FCI, the goal of the FMCE is also intended to measure students' conceptual understanding of Newtonian mechanics. It comprises of 47 multiple-choice items.

Usage

data(FMCE)

Format

A data frame of students' responses on the following 47 FMCE multiple choice items.

FMCE1 A student's response on the FMCE item number 1.

FMCE2 A student's response on the FMCE item number 2.

FMCE3 A student's response on the FMCE item number 3.

FMCE4 A student's response on the FMCE item number 4.

FMCE5 A student's response on the FMCE item number 5.

FMCE6 A student's response on the FMCE item number 6.

FMCE7 A student's response on the FMCE item number 7.

FMCE8 A student's response on the FMCE item number 8.

FMCE9 A student's response on the FMCE item number 9.

FMCE10 A student's response on the FMCE item number 10.

FMCE11 A student's response on the FMCE item number 11.

FMCE12 A student's response on the FMCE item number 12.

FMCE13 A student's response on the FMCE item number 13.

FMCE14 A student's response on the FMCE item number 14.

FMCE15 A student's response on the FMCE item number 15.

FMCE16 A student's response on the FMCE item number 16.

FMCE17 A student's response on the FMCE item number 17.

FMCE18 A student's response on the FMCE item number 18.

FMCE19 A student's response on the FMCE item number 19.

FMCE20 A student's response on the FMCE item number 20.

FMCE21 A student's response on the FMCE item number 21.

FMCE22 A student's response on the FMCE item number 22.

FMCE23 A student's response on the FMCE item number 23.

FMCE24 A student's response on the FMCE item number 24.

FMCE25 A student's response on the FMCE item number 25.
FMCE26 A student's response on the FMCE item number 26.
FMCE27 A student's response on the FMCE item number 27.
FMCE28 A student's response on the FMCE item number 28.
FMCE29 A student's response on the FMCE item number 29.
FMCE30 A student's response on the FMCE item number 30.
FMCE31 A student's response on the FMCE item number 31.
FMCE32 A student's response on the FMCE item number 32.
FMCE33 A student's response on the FMCE item number 33.
FMCE34 A student's response on the FMCE item number 34.
FMCE35 A student's response on the FMCE item number 35.
FMCE36 A student's response on the FMCE item number 36.
FMCE37 A student's response on the FMCE item number 37.
FMCE38 A student's response on the FMCE item number 38.
FMCE39 A student's response on the FMCE item number 39.
FMCE40 A student's response on the FMCE item number 40.
FMCE41 A student's response on the FMCE item number 41.
FMCE42 A student's response on the FMCE item number 42.
FMCE43 A student's response on the FMCE item number 43.
FMCE44 A student's response on the FMCE item number 44.
FMCE45 A student's response on the FMCE item number 45.
FMCE46 A student's response on the FMCE item number 46.
FMCE47 A student's response on the FMCE item number 47.

Source

Santoso, P. H. et al. SPHERE: Students' performance dataset of conceptual understanding, scientific ability, and learning attitude in physics education research (PER). *Mendeley Data*, VI, (2024). doi: 10.17632/88d7m2fv7p.1.

References

Thornton, R. K. & Sokoloff, D. R. Assessing student learning of Newton's laws: The Force and Motion Conceptual Evaluation and the Evaluation of Active Learning Laboratory and Lecture Curricula. *Am J Phys* 66, 338–352 (1998).

Examples

```
library(spheredata)
# Call the data from spheredata package
get("FMCE")
# Open the data
FMCE
```

FMCEcontentvalidity *The Force and Motion Conceptual Evaluation (FMCE) content validity dataset*

Description

In this data, five PER experts rated the content validity of the FMCE.

Usage

`data(FMCEcontentvalidity)`

Format

A data frame of expert ratings on the content validity of 47 FMCE items.

ID An anonymized expert identity.

FMCE1 A numeric value of expert rating to the FMCE item number 1.

FMCE2 A numeric value of expert rating to the FMCE item number 2.

FMCE3 A numeric value of expert rating to the FMCE item number 3.

FMCE4 A numeric value of expert rating to the FMCE item number 4.

FMCE5 A numeric value of expert rating to the FMCE item number 5.

FMCE6 A numeric value of expert rating to the FMCE item number 6.

FMCE7 A numeric value of expert rating to the FMCE item number 7.

FMCE8 A numeric value of expert rating to the FMCE item number 8.

FMCE9 A numeric value of expert rating to the FMCE item number 9.

FMCE10 A numeric value of expert rating to the FMCE item number 10.

FMCE11 A numeric value of expert rating to the FMCE item number 11.

FMCE12 A numeric value of expert rating to the FMCE item number 12.

FMCE13 A numeric value of expert rating to the FMCE item number 13.

FMCE14 A numeric value of expert rating to the FMCE item number 14.

FMCE15 A numeric value of expert rating to the FMCE item number 15.

FMCE16 A numeric value of expert rating to the FMCE item number 16.

FMCE17 A numeric value of expert rating to the FMCE item number 17.

FMCE18 A numeric value of expert rating to the FMCE item number 18.

FMCE19 A numeric value of expert rating to the FMCE item number 19.

FMCE20 A numeric value of expert rating to the FMCE item number 20.

FMCE21 A numeric value of expert rating to the FMCE item number 21.

FMCE22 A numeric value of expert rating to the FMCE item number 22.

FMCE23 A numeric value of expert rating to the FMCE item number 23.

FMCE24 A numeric value of expert rating to the FMCE item number 24.
FMCE25 A numeric value of expert rating to the FMCE item number 25.
FMCE26 A numeric value of expert rating to the FMCE item number 26.
FMCE27 A numeric value of expert rating to the FMCE item number 27.
FMCE28 A numeric value of expert rating to the FMCE item number 28.
FMCE29 A numeric value of expert rating to the FMCE item number 29.
FMCE30 A numeric value of expert rating to the FMCE item number 30.
FMCE31 A numeric value of expert rating to the FMCE item number 31.
FMCE32 A numeric value of expert rating to the FMCE item number 32.
FMCE33 A numeric value of expert rating to the FMCE item number 33.
FMCE34 A numeric value of expert rating to the FMCE item number 34.
FMCE35 A numeric value of expert rating to the FMCE item number 35.
FMCE36 A numeric value of expert rating to the FMCE item number 36.
FMCE37 A numeric value of expert rating to the FMCE item number 37.
FMCE38 A numeric value of expert rating to the FMCE item number 38.
FMCE39 A numeric value of expert rating to the FMCE item number 39.
FMCE40 A numeric value of expert rating to the FMCE item number 40.
FMCE41 A numeric value of expert rating to the FMCE item number 41.
FMCE42 A numeric value of expert rating to the FMCE item number 42.
FMCE43 A numeric value of expert rating to the FMCE item number 43.
FMCE44 A numeric value of expert rating to the FMCE item number 44.
FMCE45 A numeric value of expert rating to the FMCE item number 45.
FMCE46 A numeric value of expert rating to the FMCE item number 46.
FMCE47 A numeric value of expert rating to the FMCE item number 47.

Examples

```
library(spheredata)
# Call the data from spheredata package
get("FMCEcontentvalidity")
# Open the data
FMCEcontentvalidity
```

FMCEkey

The Force and Motion Conceptual Evaluation (FMCE) key dataset

Description

The answers key to analyze the students' obtained score on the FMCE.

Usage

data(FMCEkey)

Format

A data frame of answer keys on the following 47 FMCE items.

FMCE1 A key of the FMCE item number 1.

FMCE2 A key of the FMCE item number 2.

FMCE3 A key of the FMCE item number 3.

FMCE4 A key of the FMCE item number 4.

FMCE5 A key of the FMCE item number 5.

FMCE6 A key of the FMCE item number 6.

FMCE7 A key of the FMCE item number 7.

FMCE8 A key of the FMCE item number 8.

FMCE9 A key of the FMCE item number 9.

FMCE10 A key of the FMCE item number 10.

FMCE11 A key of the FMCE item number 11.

FMCE12 A key of the FMCE item number 12.

FMCE13 A key of the FMCE item number 13.

FMCE14 A key of the FMCE item number 14.

FMCE15 A key of the FMCE item number 15.

FMCE16 A key of the FMCE item number 16.

FMCE17 A key of the FMCE item number 17.

FMCE18 A key of the FMCE item number 18.

FMCE19 A key of the FMCE item number 19.

FMCE20 A key of the FMCE item number 20.

FMCE21 A key of the FMCE item number 21.

FMCE22 A key of the FMCE item number 22.

FMCE23 A key of the FMCE item number 23.

FMCE24 A key of the FMCE item number 24.

FMCE25 A key of the FMCE item number 25.

FMCE26 A key of the FMCE item number 26.
FMCE27 A key of the FMCE item number 27.
FMCE28 A key of the FMCE item number 28.
FMCE29 A key of the FMCE item number 29.
FMCE30 A key of the FMCE item number 30.
FMCE31 A key of the FMCE item number 31.
FMCE32 A key of the FMCE item number 32.
FMCE33 A key of the FMCE item number 33.
FMCE34 A key of the FMCE item number 34.
FMCE35 A key of the FMCE item number 35.
FMCE36 A key of the FMCE item number 36.
FMCE37 A key of the FMCE item number 37.
FMCE38 A key of the FMCE item number 38.
FMCE39 A key of the FMCE item number 39.
FMCE40 A key of the FMCE item number 40.
FMCE41 A key of the FMCE item number 41.
FMCE42 A key of the FMCE item number 42.
FMCE43 A key of the FMCE item number 43.
FMCE44 A key of the FMCE item number 44.
FMCE45 A key of the FMCE item number 45.
FMCE46 A key of the FMCE item number 46.
FMCE47 A key of the FMCE item number 47.

Examples

```
library(spheredata)
# Call the data from spheredata package
get("FMCEkey")
# Open the data
FMCEkey
```

FMCI

The Fluid Mechanics Concept Inventory (FMCI) dataset

Description

The Fluid Mechanics Concept Inventory (FMCI) is developed in 2003 as a conceptual inventory to explore students' ideas of fluid mechanics concepts [see Martin et al. (2003)]. The FMCI administers 30 multiple choice items.

Usage

```
data(FMCI)
```

Format

A data frame of students' responses on the following 30 FMCI multiple choice items. The FMCI numbering system starts from the item 3.

- FMCI3 A student's response on the FMCI item number 3.
- FMCI4 A student's response on the FMCI item number 4.
- FMCI5 A student's response on the FMCI item number 5.
- FMCI6 A student's response on the FMCI item number 6.
- FMCI7 A student's response on the FMCI item number 7.
- FMCI8 A student's response on the FMCI item number 8.
- FMCI9 A student's response on the FMCI item number 9.
- FMCI10 A student's response on the FMCI item number 10.
- FMCI11 A student's response on the FMCI item number 11.
- FMCI12 A student's response on the FMCI item number 12.
- FMCI13 A student's response on the FMCI item number 13.
- FMCI14 A student's response on the FMCI item number 14.
- FMCI15 A student's response on the FMCI item number 15.
- FMCI16 A student's response on the FMCI item number 16.
- FMCI17 A student's response on the FMCI item number 17.
- FMCI18 A student's response on the FMCI item number 18.
- FMCI19 A student's response on the FMCI item number 19.
- FMCI20 A student's response on the FMCI item number 20.
- FMCI21 A student's response on the FMCI item number 21.
- FMCI22 A student's response on the FMCI item number 22.
- FMCI23 A student's response on the FMCI item number 23.
- FMCI24 A student's response on the FMCI item number 24.
- FMCI25 A student's response on the FMCI item number 25.
- FMCI26 A student's response on the FMCI item number 26.
- FMCI27 A student's response on the FMCI item number 27.
- FMCI28 A student's response on the FMCI item number 28.
- FMCI29 A student's response on the FMCI item number 29.
- FMCI30 A student's response on the FMCI item number 30.
- FMCI31 A student's response on the FMCI item number 31.
- FMCI32 A student's response on the FMCI item number 32.

Source

Santoso, P. H. et al. SPHERE: Students' performance dataset of conceptual understanding, scientific ability, and learning attitude in physics education research (PER). *Mendeley Data*, VI, (2024). doi: 10.17632/88d7m2fv7p.1.

References

Martin, J., Mitchell, J. & Newell, T. Development of a concept inventory for fluid mechanics. in *Proceedings of the 33rd Annual Frontiers in Education 2003 vol. 1 T3D* (IEEE, 2003).

Examples

```
library(spheredata)
# Call the data from spheredata package
get("FMCI")
# Open the data
FMCI
```

FMCIcontentvalidity *The Fluid Mechanics Concept Inventory (FMCI) content validity dataset*

Description

In this data, five PER experts rated the content validity of the FMCI.

Usage

```
data(FMCIcontentvalidity)
```

Format

A data frame of expert ratings on the content validity of 30 FMCI items.

ID An anonymized expert identity.

FMCI3 A numeric value of expert rating to the FMCI item number 3.

FMCI4 A numeric value of expert rating to the FMCI item number 4.

FMCI5 A numeric value of expert rating to the FMCI item number 5.

FMCI6 A numeric value of expert rating to the FMCI item number 6.

FMCI7 A numeric value of expert rating to the FMCI item number 7.

FMCI8 A numeric value of expert rating to the FMCI item number 8.

FMCI9 A numeric value of expert rating to the FMCI item number 9.

FMCI10 A numeric value of expert rating to the FMCI item number 10.

FMCI11 A numeric value of expert rating to the FMCI item number 11.

FMCI12 A numeric value of expert rating to the FMCI item number 12.

FMCI13 A numeric value of expert rating to the FMCI item number 13.
FMCI14 A numeric value of expert rating to the FMCI item number 14.
FMCI15 A numeric value of expert rating to the FMCI item number 15.
FMCI16 A numeric value of expert rating to the FMCI item number 16.
FMCI17 A numeric value of expert rating to the FMCI item number 17.
FMCI18 A numeric value of expert rating to the FMCI item number 18.
FMCI19 A numeric value of expert rating to the FMCI item number 19.
FMCI20 A numeric value of expert rating to the FMCI item number 20.
FMCI21 A numeric value of expert rating to the FMCI item number 21.
FMCI22 A numeric value of expert rating to the FMCI item number 22.
FMCI23 A numeric value of expert rating to the FMCI item number 23.
FMCI24 A numeric value of expert rating to the FMCI item number 24.
FMCI25 A numeric value of expert rating to the FMCI item number 25.
FMCI26 A numeric value of expert rating to the FMCI item number 26.
FMCI27 A numeric value of expert rating to the FMCI item number 27.
FMCI28 A numeric value of expert rating to the FMCI item number 28.
FMCI29 A numeric value of expert rating to the FMCI item number 29.
FMCI30 A numeric value of expert rating to the FMCI item number 30.
FMCI31 A numeric value of expert rating to the FMCI item number 31.
FMCI32 A numeric value of expert rating to the FMCI item number 32.

Examples

```
library(spheredata)
# Call the data from spheredata package
get("FMCIcontentvalidity")
# Open the data
FMCIcontentvalidity
```

FMCIkey

The Fluid Mechanics Concept Inventory (FMCI) key dataset

Description

The answers key to analyze the students' obtained score on the FMCI.

Usage

```
data(FMCIkey)
```

Format

A data frame of a key record on the following 30 FMCI items. The FMCI numbering system starts from the item 3.

FMCI3 A key of the FMCI item number 3.
FMCI4 A key of the FMCI item number 4.
FMCI5 A key of the FMCI item number 5.
FMCI6 A key of the FMCI item number 6.
FMCI7 A key of the FMCI item number 7.
FMCI8 A key of the FMCI item number 8.
FMCI9 A key of the FMCI item number 9.
FMCI10 A key of the FMCI item number 10.
FMCI11 A key of the FMCI item number 11.
FMCI12 A key of the FMCI item number 12.
FMCI13 A key of the FMCI item number 13.
FMCI14 A key of the FMCI item number 14.
FMCI15 A key of the FMCI item number 15.
FMCI16 A key of the FMCI item number 16.
FMCI17 A key of the FMCI item number 17.
FMCI18 A key of the FMCI item number 18.
FMCI19 A key of the FMCI item number 19.
FMCI20 A key of the FMCI item number 20.
FMCI21 A key of the FMCI item number 21.
FMCI22 A key of the FMCI item number 22.
FMCI23 A key of the FMCI item number 23.
FMCI24 A key of the FMCI item number 24.
FMCI25 A key of the FMCI item number 25.
FMCI26 A key of the FMCI item number 26.
FMCI27 A key of the FMCI item number 27.
FMCI28 A key of the FMCI item number 28.
FMCI29 A key of the FMCI item number 29.
FMCI30 A key of the FMCI item number 30.
FMCI31 A key of the FMCI item number 31.
FMCI32 A key of the FMCI item number 32.

Examples

```
library(spheredata)
# Call the data from spheredata package
get("FMCIkey")
# Open the data
FMCIkey
```

lawsheCVR

Compute the Lawshe's content validity ratio (CVR)

Description

Lawshe (1975) proposed an index to quantify content validity of items as assessed by experts. He coined the index as content validity ratio (*CVR*) that can be calculated using the following formula.

$$CVR = \frac{n_e - \frac{N}{2}}{\frac{N}{2}}$$

where n_e is the number of experts identifying an item as essential. In this function, we define a cutoff value using two methods. The first is "max" calculated by searching the maximum value of the used rating scale ("max_cat") and then divide it by two. The second method is "min" by using the minimum value of the used rating scale ("min_cat") as the cutoff criteria.

Usage

```
lawsheCVR(data, max_cat = 4, min_cat = 1, method = "max")
```

Arguments

data	a dataframe of categorical value from expert judgment to the item content validity.
max_cat	a maximum category point of used rating scale (the default value is 4).
min_cat	a minimum category point of used rating scale (the default value is 1).
method	a method to determine cutoff value between essential and non-essential items

Value

a dataframe of CVR of each item as calculated using the Lawshe's formula

References

Gilbert, G.E. & Prion, S. Making Sense of Methods and Measurement: Lawshe's Content Validity Index. *Clinical Simulation in Nursing* 12, 530-531 (2016).

Lawshe, C.H. A Quantitative Approach of Content Validity. *Personnel Psychology* 28, 563-575 (1975).

Examples

```
# In this example, we define a dataframe describing the rating of ten
# imaginary items as assessed by seven artificial experts. The minimum point
# of the rating scale is 1, and the maximum point that could be given by
# those experts is 4.
```

```
df <- data.frame(item1 = c(3,3,3,4,4,4,3),
```



```
item2 = c(2,4,3,2,4,4,4),
item3 = c(4,3,3,2,4,4,3),
item4 = c(3,2,3,3,4,3,3),
item5 = c(4,4,4,3,3,3,3),
item6 = c(3,3,3,4,3,3,4),
item7 = c(4,4,4,3,4,4,4),
item8 = c(3,3,4,4,4,4,4),
item9 = c(4,4,4,3,4,4,4),
item10 = c(4,3,4,4,3,3,4))

# Compute the Lawshe's CVR
lawsheCVR(df)
```

literacy	<i>Students' literacy dataset</i>
----------	-----------------------------------

Description

In this package, students' literacy was defined based on two close-ended items asking the accessibility to available books in their home and digital facilities belong to the students.

Usage

```
data(literacy)
```

Format

A data frame with 497 observations on the following 2 literacy items.

LIT1 Do you read books in your home? 1 = Yes, 2 = No

LIT2 Do you access gadgets and the internet in your home? 1 = Yes, 2 = No

Source

Santoso, P. H. et al. SPHERE: Students' performance dataset of conceptual understanding, scientific ability, and learning attitude in physics education research (PER). *Mendeley Data, V1*, (2024). doi: 10.17632/88d7m2fv7p.1.

Examples

```
library(spheredata)
# Call the data from spheredata package
get("literacy")
# Open the data
literacy
```

MWCS

The Mechanical Waves Conceptual Survey (MWCS) dataset

Description

The MWCS is the most important test to date that has been designed to evaluate students' understanding of four main topics in mechanical waves. It encompasses some concepts surrounding propagation, superposition, reflection, and standing waves within 22 multiple choice items.

Usage

`data(MWCS)`

Format

A data frame of students' responses on the following 22 MWCS multiple choice items.

- MWCS1 A student's response on the MWCS item number 1.
- MWCS2 A student's response on the MWCS item number 2.
- MWCS3 A student's response on the MWCS item number 3.
- MWCS4 A student's response on the MWCS item number 4.
- MWCS5 A student's response on the MWCS item number 5.
- MWCS6 A student's response on the MWCS item number 6.
- MWCS7 A student's response on the MWCS item number 7.
- MWCS8 A student's response on the MWCS item number 8.
- MWCS9 A student's response on the MWCS item number 9.
- MWCS10 A student's response on the MWCS item number 10.
- MWCS11 A student's response on the MWCS item number 11.
- MWCS12 A student's response on the MWCS item number 12.
- MWCS13 A student's response on the MWCS item number 13.
- MWCS14 A student's response on the MWCS item number 14.
- MWCS15 A student's response on the MWCS item number 15.
- MWCS16 A student's response on the MWCS item number 16.
- MWCS17 A student's response on the MWCS item number 17.
- MWCS18 A student's response on the MWCS item number 18.
- MWCS19 A student's response on the MWCS item number 19.
- MWCS20 A student's response on the MWCS item number 20.
- MWCS21 A student's response on the MWCS item number 21.
- MWCS22 A student's response on the MWCS item number 22.

Source

Santoso, P. H. et al. SPHERE: Students' performance dataset of conceptual understanding, scientific ability, and learning attitude in physics education research (PER). *Mendeley Data*, VI, (2024). doi: 10.17632/88d7m2fv7p.1.

References

Barniol, P. & Zavala, G. Mechanical waves conceptual survey: Its modification and conversion to a standard multiple-choice test. *Phys Rev Phys Educ Res* 12, 010107 (2016).

Examples

```
library(spheredata)
# Call the data from spheredata package
get("MWCS")
# Open the data
MWCS
```

MWCScontentvalidity	<i>The Mechanical Waves Conceptual Survey (MWCS) content validity dataset</i>
---------------------	---

Description

In this data, five PER experts rated the content validity of the MWCS.

Usage

```
data(MWCScontentvalidity)
```

Format

A data frame of expert ratings on the content validity of 22 MWCS items.

ID An anonymized expert identity.

MWCS1 A numeric value of expert rating to the MWCS item number 1.

MWCS2 A numeric value of expert rating to the MWCS item number 2.

MWCS3 A numeric value of expert rating to the MWCS item number 3.

MWCS4 A numeric value of expert rating to the MWCS item number 4.

MWCS5 A numeric value of expert rating to the MWCS item number 5.

MWCS6 A numeric value of expert rating to the MWCS item number 6.

MWCS7 A numeric value of expert rating to the MWCS item number 7.

MWCS8 A numeric value of expert rating to the MWCS item number 8.

MWCS9 A numeric value of expert rating to the MWCS item number 9.

MWCS10 A numeric value of expert rating to the MWCS item number 10.

MWCS11 A numeric value of expert rating to the MWCS item number 11.
 MWCS12 A numeric value of expert rating to the MWCS item number 12.
 MWCS13 A numeric value of expert rating to the MWCS item number 13.
 MWCS14 A numeric value of expert rating to the MWCS item number 14.
 MWCS15 A numeric value of expert rating to the MWCS item number 15.
 MWCS16 A numeric value of expert rating to the MWCS item number 16.
 MWCS17 A numeric value of expert rating to the MWCS item number 17.
 MWCS18 A numeric value of expert rating to the MWCS item number 18.
 MWCS19 A numeric value of expert rating to the MWCS item number 19.
 MWCS20 A numeric value of expert rating to the MWCS item number 20.
 MWCS21 A numeric value of expert rating to the MWCS item number 21.
 MWCS22 A numeric value of expert rating to the MWCS item number 22.

Examples

```
library(spheredata)
# Call the data from spheredata package
get("MWCScontentvalidity")
# Open the data
MWCScontentvalidity
```

MWCSkey

The Mechanical Waves Conceptual Survey (MWCS) key dataset

Description

The answers key to analyze the students' obtained score on the MWCS.

Usage

```
data(MWCSkey)
```

Format

A data frame of a key record on the following 22 MWCS items.

MWCS1 A key of the MWCS item number 1.
 MWCS2 A key of the MWCS item number 2.
 MWCS3 A key of the MWCS item number 3.
 MWCS4 A key of the MWCS item number 4.
 MWCS5 A key of the MWCS item number 5.
 MWCS6 A key of the MWCS item number 6.
 MWCS7 A key of the MWCS item number 7.

MWCS8 A key of the MWCS item number 8.
 MWCS9 A key of the MWCS item number 9.
 MWCS10 A key of the MWCS item number 10.
 MWCS11 A key of the MWCS item number 11.
 MWCS12 A key of the MWCS item number 12.
 MWCS13 A key of the MWCS item number 13.
 MWCS14 A key of the MWCS item number 14.
 MWCS15 A key of the MWCS item number 15.
 MWCS16 A key of the MWCS item number 16.
 MWCS17 A key of the MWCS item number 17.
 MWCS18 A key of the MWCS item number 18.
 MWCS19 A key of the MWCS item number 19.
 MWCS20 A key of the MWCS item number 20.
 MWCS21 A key of the MWCS item number 21.
 MWCS22 A key of the MWCS item number 22.

Examples

```
library(spheredata)
# Call the data from spheredata package
get("MWCSkey")
# Open the data
MWCSkey
```

physicsidentity *Students' physics identity dataset*

Description

In this study, students' physics identity was defined based on two close-ended items asking the students' study time for physics and the experienced family recognition when they are studying physics.

Usage

```
data(physicsidentity)
```

Format

A data frame with 497 observations on the following 2 physics identity items.

PHYIDE1 When did you study physics outside schools? 1 = Most of the time, 2 = Night before the physics schedule, 3 = Night before exam, 4 = Never

PHYIDE2 Did your parents support you while studying physics? 1 = Yes, 2 = Lack of parental support, 3 = Extremely no

Source

Santoso, P. H. et al. SPHERE: Students' performance dataset of conceptual understanding, scientific ability, and learning attitude in physics education research (PER). *Mendeley Data*, VI, (2024). doi: 10.17632/88d7m2fv7p.1.

References

Hazari, Z., Sonnert, G., Sadler, P. M. & Shanahan, M. C. Connecting high school physics experiences, outcome expectations, physics identity, and physics career choice: A gender study. *J Res Sci Teach* 47, 978–1003 (2010).

Examples

```
library(spheredata)
# Call the data from spheredata package
get("physicsidentity")
# Open the data
physicsidentity
```

RRMCS

The Rotational and Rolling Motion Conceptual Survey (RRMCS) dataset

Description

The RRMCS could be given to explore students' ideas in various education levels starting in high school to introductory college. It examines students' understanding of rotational motion and notions associated with it through 30 multiple choice items.

Usage

```
data(RRMCS)
```

Format

A data frame of students' responses on the following 30 RRMCS multiple choice items.

RRMCS1 A student's response on the RRMCS item number 1.

RRMCS2 A student's response on the RRMCS item number 2.

RRMCS3 A student's response on the RRMCS item number 3.

RRMCS4 A student's response on the RRMCS item number 4.

RRMCS5 A student's response on the RRMCS item number 5.

RRMCS6 A student's response on the RRMCS item number 6.

RRMCS7 A student's response on the RRMCS item number 7.

RRMCS8 A student's response on the RRMCS item number 8.

- RRMCS9 A student's response on the RRMCS item number 9.
- RRMCS10 A student's response on the RRMCS item number 10.
- RRMCS11 A student's response on the RRMCS item number 11.
- RRMCS12 A student's response on the RRMCS item number 12.
- RRMCS13 A student's response on the RRMCS item number 13.
- RRMCS14 A student's response on the RRMCS item number 14.
- RRMCS15 A student's response on the RRMCS item number 15.
- RRMCS16 A student's response on the RRMCS item number 16.
- RRMCS17 A student's response on the RRMCS item number 17.
- RRMCS18 A student's response on the RRMCS item number 18.
- RRMCS19 A student's response on the RRMCS item number 19.
- RRMCS20 A student's response on the RRMCS item number 20.
- RRMCS21 A student's response on the RRMCS item number 21.
- RRMCS22 A student's response on the RRMCS item number 22.
- RRMCS23 A student's response on the RRMCS item number 23.
- RRMCS24 A student's response on the RRMCS item number 24.
- RRMCS25 A student's response on the RRMCS item number 25.
- RRMCS26 A student's response on the RRMCS item number 26.
- RRMCS27 A student's response on the RRMCS item number 27.
- RRMCS28 A student's response on the RRMCS item number 28.
- RRMCS29 A student's response on the RRMCS item number 29.
- RRMCS30 A student's response on the RRMCS item number 30.

Source

Santoso, P. H. et al. SPHERE: Students' performance dataset of conceptual understanding, scientific ability, and learning attitude in physics education research (PER). *Mendeley Data*, VI, (2024). doi: 10.17632/88d7m2fv7p.1.

References

Rimoldini, L. G. & Singh, C. Student understanding of rotational and rolling motion concepts. *Physical Review Special Topics - Physics Education Research* 1, 010102 (2005).

Examples

```
library(spheredata)
# Call the data from spheredata package
get("RRMCS")
# Open the data
RRMCS
```

RRMCScontentvalidity *The Rotational and Rolling Motion Conceptual Survey (RRMCS) content validity dataset*

Description

In this data, five PER experts rated the content validity of the RRMCS.

Usage

`data(RRMCScontentvalidity)`

Format

A data frame of expert ratings on the content validity of 30 RRMCS items.

ID An anonymized expert identity.

RRMCS1 A numeric value of expert rating to the RRMCS item number 1.

RRMCS2 A numeric value of expert rating to the RRMCS item number 2.

RRMCS3 A numeric value of expert rating to the RRMCS item number 3.

RRMCS4 A numeric value of expert rating to the RRMCS item number 4.

RRMCS5 A numeric value of expert rating to the RRMCS item number 5.

RRMCS6 A numeric value of expert rating to the RRMCS item number 6.

RRMCS7 A numeric value of expert rating to the RRMCS item number 7.

RRMCS8 A numeric value of expert rating to the RRMCS item number 8.

RRMCS9 A numeric value of expert rating to the RRMCS item number 9.

RRMCS10 A numeric value of expert rating to the RRMCS item number 10.

RRMCS11 A numeric value of expert rating to the RRMCS item number 11.

RRMCS12 A numeric value of expert rating to the RRMCS item number 12.

RRMCS13 A numeric value of expert rating to the RRMCS item number 13.

RRMCS14 A numeric value of expert rating to the RRMCS item number 14.

RRMCS15 A numeric value of expert rating to the RRMCS item number 15.

RRMCS16 A numeric value of expert rating to the RRMCS item number 16.

RRMCS17 A numeric value of expert rating to the RRMCS item number 17.

RRMCS18 A numeric value of expert rating to the RRMCS item number 18.

RRMCS19 A numeric value of expert rating to the RRMCS item number 19.

RRMCS20 A numeric value of expert rating to the RRMCS item number 20.

RRMCS21 A numeric value of expert rating to the RRMCS item number 21.

RRMCS22 A numeric value of expert rating to the RRMCS item number 22.

RRMCS23 A numeric value of expert rating to the RRMCS item number 23.

- RRMCS24 A numeric value of expert rating to the RRMCS item number 24.
 RRMCS25 A numeric value of expert rating to the RRMCS item number 25.
 RRMCS26 A numeric value of expert rating to the RRMCS item number 26.
 RRMCS27 A numeric value of expert rating to the RRMCS item number 27.
 RRMCS28 A numeric value of expert rating to the RRMCS item number 28.
 RRMCS29 A numeric value of expert rating to the RRMCS item number 29.
 RRMCS30 A numeric value of expert rating to the RRMCS item number 30.

Source

Santoso, P. H. et al. SPHERE: Students' performance dataset of conceptual understanding, scientific ability, and learning attitude in physics education research (PER). *Mendeley Data, VI*, (2024). doi: 10.17632/88d7m2fv7p.1.

Examples

```
library(spheredata)
# Call the data from spheredata package
get("RRMCScontentvalidity")
# Open the data
RRMCScontentvalidity
```

RRMCSkey	<i>The Rotational and Rolling Motion Conceptual Survey (RRMCS) key dataset</i>
----------	--

Description

The answers key to analyze the students' obtained score on the RRMCS.

Usage

```
data(RRMCSkey)
```

Format

A data frame of answer keys on the following 30 RRMCS items.

- RRMCS1 A key of the RRMCS item number 1.
 RRMCS2 A key of the RRMCS item number 2.
 RRMCS3 A key of the RRMCS item number 3.
 RRMCS4 A key of the RRMCS item number 4.
 RRMCS5 A key of the RRMCS item number 5.
 RRMCS6 A key of the RRMCS item number 6.
 RRMCS7 A key of the RRMCS item number 7.

RRMCS8 A key of the RRMCS item number 8.
RRMCS9 A key of the RRMCS item number 9.
RRMCS10 A key of the RRMCS item number 10.
RRMCS11 A key of the RRMCS item number 11.
RRMCS12 A key of the RRMCS item number 12.
RRMCS13 A key of the RRMCS item number 13.
RRMCS14 A key of the RRMCS item number 14.
RRMCS15 A key of the RRMCS item number 15.
RRMCS16 A key of the RRMCS item number 16.
RRMCS17 A key of the RRMCS item number 17.
RRMCS18 A key of the RRMCS item number 18.
RRMCS19 A key of the RRMCS item number 19.
RRMCS20 A key of the RRMCS item number 20.
RRMCS21 A key of the RRMCS item number 21.
RRMCS22 A key of the RRMCS item number 22.
RRMCS23 A key of the RRMCS item number 23.
RRMCS24 A key of the RRMCS item number 24.
RRMCS25 A key of the RRMCS item number 25.
RRMCS26 A key of the RRMCS item number 26.
RRMCS27 A key of the RRMCS item number 27.
RRMCS28 A key of the RRMCS item number 28.
RRMCS29 A key of the RRMCS item number 29.
RRMCS30 A key of the RRMCS item number 30.

Examples

```
library(spheredata)
# Call the data from spheredata package
get("RRMCSkey")
# Open the data
RRMCSkey
```

Description

The SAAR is developed as a qualitative scoring rubric intended to measure students' scientific abilities within the environment of physics laboratory. A rating scale with four categories (1–4) is used in this dataset to describe the students' work in the laboratory (1, missing; 2, inadequate; 3, needs some improvement; and 4, adequate) and devised descriptions of student work that could merit a particular score. In this package, we merely measure some abilities from the SAAR since they could be more relevant and important for the high school physics laboratory. They are the ability to design & conduct an observational experiment (Rubric B), the ability to communicate scientific ideas (Rubric F), and the ability to collect and analyze experimental data (Rubric G).

Usage

```
data(SAAR)
```

Format

A data frame of students' performance in the physics laboratory measured by the following 16 SAAR observation items.

- SAARB1 An observation using SAAR on the Rubric B item 1.
- SAARB2 An observation using SAAR on the Rubric B item 2.
- SAARB3 An observation using SAAR on the Rubric B item 3.
- SAARB4 An observation using SAAR on the Rubric B item 4.
- SAARB5 An observation using SAAR on the Rubric B item 5.
- SAARB6 An observation using SAAR on the Rubric B item 6.
- SAARB7 An observation using SAAR on the Rubric B item 7.
- SAARB8 An observation using SAAR on the Rubric B item 8.
- SAARB9 An observation using SAAR on the Rubric B item 9.
- SAARF10 An observation using SAAR on the Rubric F item 1 (SAAR item 10).
- SAARF11 An observation using SAAR on the Rubric F item 2 (SAAR item 11).
- SAARG12 An observation using SAAR on the Rubric G item 1 (SAAR item 12).
- SAARG13 An observation using SAAR on the Rubric G item 2 (SAAR item 13).
- SAARG14 An observation using SAAR on the Rubric G item 3 (SAAR item 14).
- SAARG15 An observation using SAAR on the Rubric G item 4 (SAAR item 15).
- SAARG16 An observation using SAAR on the Rubric G item 5 (SAAR item 16).

Source

Santoso, P. H. et al. SPHERE: Students' performance dataset of conceptual understanding, scientific ability, and learning attitude in physics education research (PER). *Mendeley Data*, V1, (2024). doi: 10.17632/88d7m2fv7p.1

References

Etkina, E. et al. Scientific abilities and their assessment. *Physical Review Special Topics - Physics Education Research* 2, 020103 (2006).

Examples

```
library(spheredata)
# Call the data from spheredata package
get("SAAR")
# Open the data
SAAR
```

SAARcontentvalidity	<i>The Scientific Abilities Assessment Rubrics (SAAR) content validity dataset</i>
---------------------	--

Description

In this data, five PER experts rated the content validity of the STPFASL.

Usage

```
data(SAARcontentvalidity)
```

Format

A data frame of expert ratings on the content validity of 16 SAAR observation items.

ID An anonymized expert identity.

SAARB1 A numeric of expert rating on the SAAR Rubric B item 1.

SAARB2 A numeric of expert rating on the SAAR Rubric B item 2.

SAARB3 A numeric of expert rating on the SAAR Rubric B item 3.

SAARB4 A numeric of expert rating on the SAAR Rubric B item 4.

SAARB5 A numeric of expert rating on the SAAR Rubric B item 5.

SAARB6 A numeric of expert rating on the SAAR Rubric B item 6.

SAARB7 A numeric of expert rating on the SAAR Rubric B item 7.

SAARB8 A numeric of expert rating on the SAAR Rubric B item 8.

SAARB9 A numeric of expert rating on the SAAR Rubric B item 9.

SAARF10 A numeric of expert rating on the SAAR Rubric F item 1.

SAARF11 A numeric of expert rating on the SAAR Rubric F item 2.

SAARG12 A numeric of expert rating on the SAAR Rubric G item 1.

SAARG13 A numeric of expert rating on the SAAR Rubric G item 2.

SAARG14 A numeric of expert rating on the SAAR Rubric G item 3.

SAARG15 A numeric of expert rating on the SAAR Rubric G item 4.

SAARG16 A numeric of expert rating on the SAAR Rubric G item 5.

Examples

```
library(spheredata)
# Call the data from spheredata package
get("SAARcontentvalidity")
# Open the data
SAARcontentvalidity
```

STPFASL

The Survey of Thermodynamic Processes and First and Second Laws (STPFASL) dataset

Description

The STPFASL instrument demonstrates 33 items in multiple-choice format that are written based on common student difficulties of thermodynamics as resources in that the incorrect answers to the multiple-choice questions were guided by them.

Usage

```
data(STPFASL)
```

Format

A data frame of students' responses on the following 47 STPFASL multiple choice items.

- STPFASL1 A student's response on the STPFASL item number 1.
- STPFASL2 A student's response on the STPFASL item number 2.
- STPFASL3 A student's response on the STPFASL item number 3.
- STPFASL4 A student's response on the STPFASL item number 4.
- STPFASL5 A student's response on the STPFASL item number 5.
- STPFASL6 A student's response on the STPFASL item number 6.
- STPFASL7 A student's response on the STPFASL item number 7.
- STPFASL8 A student's response on the STPFASL item number 8.
- STPFASL9 A student's response on the STPFASL item number 9.
- STPFASL10 A student's response on the STPFASL item number 10.
- STPFASL11 A student's response on the STPFASL item number 11.
- STPFASL12 A student's response on the STPFASL item number 12.
- STPFASL13 A student's response on the STPFASL item number 13.
- STPFASL14 A student's response on the STPFASL item number 14.
- STPFASL15 A student's response on the STPFASL item number 15.
- STPFASL16 A student's response on the STPFASL item number 16.
- STPFASL17 A student's response on the STPFASL item number 17.

- STPFASL18 A student's response on the STPFASL item number 18.
- STPFASL19 A student's response on the STPFASL item number 19.
- STPFASL20 A student's response on the STPFASL item number 20.
- STPFASL21 A student's response on the STPFASL item number 21.
- STPFASL22 A student's response on the STPFASL item number 22.
- STPFASL23 A student's response on the STPFASL item number 23.
- STPFASL24 A student's response on the STPFASL item number 24.
- STPFASL25 A student's response on the STPFASL item number 25.
- STPFASL26 A student's response on the STPFASL item number 26.
- STPFASL27 A student's response on the STPFASL item number 27.
- STPFASL28 A student's response on the STPFASL item number 28.
- STPFASL29 A student's response on the STPFASL item number 29.
- STPFASL30 A student's response on the STPFASL item number 30.
- STPFASL31 A student's response on the STPFASL item number 31.
- STPFASL32 A student's response on the STPFASL item number 32.
- STPFASL33 A student's response on the STPFASL item number 33.

Source

Santoso, P. H. et al. SPHERE: Students' performance dataset of conceptual understanding, scientific ability, and learning attitude in physics education research (PER). *Mendeley Data*, VI, (2024). doi: 10.17632/88d7m2fv7p.1.

References

Brown, B. & Singh, C. Development and validation of a conceptual survey instrument to evaluate students' understanding of thermodynamics. *Phys Rev Phys Educ Res* 17, 010104 (2021).

Examples

```
library(spheredata)
# Call the data from spheredata package
get("STPFASL")
# Open the data
STPFASL
```

STPFASLcontentvalidity

*The Survey of Thermodynamic Processes and First and Second Laws
(STPFASL) content validity dataset*

Description

In this data, five PER experts rated the content validity of the STPFASL.

Usage

`data(STPFASLcontentvalidity)`

Format

A data frame of expert ratings on the content validity of 33 STPFASL items.

ID An anonymized expert identity.

STPFASL1 A numeric value of expert rating to the STPFASL item number 1.

STPFASL2 A numeric value of expert rating to the STPFASL item number 2.

STPFASL3 A numeric value of expert rating to the STPFASL item number 3.

STPFASL4 A numeric value of expert rating to the STPFASL item number 4.

STPFASL5 A numeric value of expert rating to the STPFASL item number 5.

STPFASL6 A numeric value of expert rating to the STPFASL item number 6.

STPFASL7 A numeric value of expert rating to the STPFASL item number 7.

STPFASL8 A numeric value of expert rating to the STPFASL item number 8.

STPFASL9 A numeric value of expert rating to the STPFASL item number 9.

STPFASL10 A numeric value of expert rating to the STPFASL item number 10.

STPFASL11 A numeric value of expert rating to the STPFASL item number 11.

STPFASL12 A numeric value of expert rating to the STPFASL item number 12.

STPFASL13 A numeric value of expert rating to the STPFASL item number 13.

STPFASL14 A numeric value of expert rating to the STPFASL item number 14.

STPFASL15 A numeric value of expert rating to the STPFASL item number 15.

STPFASL16 A numeric value of expert rating to the STPFASL item number 16.

STPFASL17 A numeric value of expert rating to the STPFASL item number 17.

STPFASL18 A numeric value of expert rating to the STPFASL item number 18.

STPFASL19 A numeric value of expert rating to the STPFASL item number 19.

STPFASL20 A numeric value of expert rating to the STPFASL item number 20.

STPFASL21 A numeric value of expert rating to the STPFASL item number 21.

STPFASL22 A numeric value of expert rating to the STPFASL item number 22.

STPFASL23 A numeric value of expert rating to the STPFASL item number 23.
 STPFASL24 A numeric value of expert rating to the STPFASL item number 24.
 STPFASL25 A numeric value of expert rating to the STPFASL item number 25.
 STPFASL26 A numeric value of expert rating to the STPFASL item number 26.
 STPFASL27 A numeric value of expert rating to the STPFASL item number 27.
 STPFASL28 A numeric value of expert rating to the STPFASL item number 28.
 STPFASL29 A numeric value of expert rating to the STPFASL item number 29.
 STPFASL30 A numeric value of expert rating to the STPFASL item number 30.
 STPFASL31 A numeric value of expert rating to the STPFASL item number 31.
 STPFASL32 A numeric value of expert rating to the STPFASL item number 32.
 STPFASL33 A numeric value of expert rating to the STPFASL item number 33.

Examples

```
library(spheredata)
# Call the data from spheredata package
get("STPFASLcontentvalidity")
# Open the data
STPFASLcontentvalidity
```

STPFASLkey

*The Survey of Thermodynamic Processes and First and Second Laws
(STPFASL) key dataset*

Description

The answers key to analyze the students' obtained score on the STPFASL.

Usage

```
data(STPFASLkey)
```

Format

A data frame of answer keys on the following 33 STPFASL items.

STPFASL1 A key of the STPFASL item number 1.
 STPFASL2 A key of the STPFASL item number 2.
 STPFASL3 A key of the STPFASL item number 3.
 STPFASL4 A key of the STPFASL item number 4.
 STPFASL5 A key of the STPFASL item number 5.
 STPFASL6 A key of the STPFASL item number 6.
 STPFASL7 A key of the STPFASL item number 7.

STPFASL8 A key of the STPFASL item number 8.
STPFASL9 A key of the STPFASL item number 9.
STPFASL10 A key of the STPFASL item number 10.
STPFASL11 A key of the STPFASL item number 11.
STPFASL12 A key of the STPFASL item number 12.
STPFASL13 A key of the STPFASL item number 13.
STPFASL14 A key of the STPFASL item number 14.
STPFASL15 A key of the STPFASL item number 15.
STPFASL16 A key of the STPFASL item number 16.
STPFASL17 A key of the STPFASL item number 17.
STPFASL18 A key of the STPFASL item number 18.
STPFASL19 A key of the STPFASL item number 19.
STPFASL20 A key of the STPFASL item number 20.
STPFASL21 A key of the STPFASL item number 21.
STPFASL22 A key of the STPFASL item number 22.
STPFASL23 A key of the STPFASL item number 23.
STPFASL24 A key of the STPFASL item number 24.
STPFASL25 A key of the STPFASL item number 25.
STPFASL26 A key of the STPFASL item number 26.
STPFASL27 A key of the STPFASL item number 27.
STPFASL28 A key of the STPFASL item number 28.
STPFASL29 A key of the STPFASL item number 29.
STPFASL30 A key of the STPFASL item number 30.
STPFASL31 A key of the STPFASL item number 31.
STPFASL32 A key of the STPFASL item number 32.
STPFASL33 A key of the STPFASL item number 33.

Examples

```
library(spheredata)
# Call the data from spheredata package
get("STPFASLkey")
# Open the data
STPFASLkey
```

TCE

The Thermal Concept Evaluation (TCE) dataset

Description

There are 26 multiple-choice items in the TCE examining students' alternative concepts on heat, temperature, heat transfer and temperature change, and thermal properties. The alternative concepts are discovered based on former studies, and they are used as a researcher basis to construct the TCE distractors.

Usage

data(TCE)

Format

A data frame of students' responses on the following 26 TCE multiple choice items.

- TCE1 A student's response on the TCE item number 1.
- TCE2 A student's response on the TCE item number 2.
- TCE3 A student's response on the TCE item number 3.
- TCE4 A student's response on the TCE item number 4.
- TCE5 A student's response on the TCE item number 5.
- TCE6 A student's response on the TCE item number 6.
- TCE7 A student's response on the TCE item number 7.
- TCE8 A student's response on the TCE item number 8.
- TCE9 A student's response on the TCE item number 9.
- TCE10 A student's response on the TCE item number 10.
- TCE11 A student's response on the TCE item number 11.
- TCE12 A student's response on the TCE item number 12.
- TCE13 A student's response on the TCE item number 13.
- TCE14 A student's response on the TCE item number 14.
- TCE15 A student's response on the TCE item number 15.
- TCE16 A student's response on the TCE item number 16.
- TCE17 A student's response on the TCE item number 17.
- TCE18 A student's response on the TCE item number 18.
- TCE19 A student's response on the TCE item number 19.
- TCE20 A student's response on the TCE item number 20.
- TCE21 A student's response on the TCE item number 21.
- TCE22 A student's response on the TCE item number 22.
- TCE23 A student's response on the TCE item number 23.
- TCE24 A student's response on the TCE item number 24.
- TCE25 A student's response on the TCE item number 25.
- TCE26 A student's response on the TCE item number 26.

Examples

```
library(spheredata)
# Call the data from spheredata package
get("TCE")
# Open the data
TCE
```

TCEcontentvalidity *The Thermal Concept Evaluation (TCE) content validity dataset*

Description

In this data, five PER experts rated the content validity of the TCE.

Usage

```
data(TCEcontentvalidity)
```

Format

A data frame of expert ratings on the content validity of 26 TCE items.

ID An anonymized expert identity.

TCE1 A numeric value of expert rating to the TCE item number 1.

TCE2 A numeric value of expert rating to the TCE item number 2.

TCE3 A numeric value of expert rating to the TCE item number 3.

TCE4 A numeric value of expert rating to the TCE item number 4.

TCE5 A numeric value of expert rating to the TCE item number 5.

TCE6 A numeric value of expert rating to the TCE item number 6.

TCE7 A numeric value of expert rating to the TCE item number 7.

TCE8 A numeric value of expert rating to the TCE item number 8.

TCE9 A numeric value of expert rating to the TCE item number 9.

TCE10 A numeric value of expert rating to the TCE item number 10.

TCE11 A numeric value of expert rating to the TCE item number 11.

TCE12 A numeric value of expert rating to the TCE item number 12.

TCE13 A numeric value of expert rating to the TCE item number 13.

TCE14 A numeric value of expert rating to the TCE item number 14.

TCE15 A numeric value of expert rating to the TCE item number 15.

TCE16 A numeric value of expert rating to the TCE item number 16.

TCE17 A numeric value of expert rating to the TCE item number 17.

TCE18 A numeric value of expert rating to the TCE item number 18.

TCE19 A numeric value of expert rating to the TCE item number 19.

TCE20 A numeric value of expert rating to the TCE item number 20.
 TCE21 A numeric value of expert rating to the TCE item number 21.
 TCE22 A numeric value of expert rating to the TCE item number 22.
 TCE23 A numeric value of expert rating to the TCE item number 23.
 TCE24 A numeric value of expert rating to the TCE item number 24.
 TCE25 A numeric value of expert rating to the TCE item number 25.
 TCE26 A numeric value of expert rating to the TCE item number 26.

Examples

```
library(spheredata)
# Call the data from spheredata package
get("TCEcontentvalidity")
# Open the data
TCEcontentvalidity
```

TCEkey

The Thermal Concept Evaluation (TCE) key dataset

Description

The answers key to analyze the students' obtained score on the TCE.

Usage

```
data(TCEkey)
```

Format

A data frame of answer keys on the following 26 TCE items.

TCE1 A key of the TCE item number 1.
 TCE2 A key of the TCE item number 2.
 TCE3 A key of the TCE item number 3.
 TCE4 A key of the TCE item number 4.
 TCE5 A key of the TCE item number 5.
 TCE6 A key of the TCE item number 6.
 TCE7 A key of the TCE item number 7.
 TCE8 A key of the TCE item number 8.
 TCE9 A key of the TCE item number 9.
 TCE10 A key of the TCE item number 10.
 TCE11 A key of the TCE item number 11.
 TCE12 A key of the TCE item number 12.

TCE13 A key of the TCE item number 13.
 TCE14 A key of the TCE item number 14.
 TCE15 A key of the TCE item number 15.
 TCE16 A key of the TCE item number 16.
 TCE17 A key of the TCE item number 17.
 TCE18 A key of the TCE item number 18.
 TCE19 A key of the TCE item number 19.
 TCE20 A key of the TCE item number 20.
 TCE21 A key of the TCE item number 21.
 TCE22 A key of the TCE item number 22.
 TCE23 A key of the TCE item number 23.
 TCE24 A key of the TCE item number 24.
 TCE25 A key of the TCE item number 25.
 TCE26 A key of the TCE item number 26.

Examples

```
library(spheredata)
# Call the data from spheredata package
get("TCEkey")
# Open the data
TCEkey
```

teachersjudgment	<i>Teachers' judgment dataset</i>
------------------	-----------------------------------

Description

In this study, physics teachers are studied to predict the binary state of their students' performance at the final second semester.

Usage

```
data(teachersjudgment)
```

Format

A data frame with 497 rows of final test assessments and prediction reported by physics teachers.

FINTEST1 Students' score on the final test at the first semester using teachers developed items.

FINTEST2 Students' score on the final test at the second semester using teachers developed items.

TEACHPRED Students' performance state as predicted by physics teachers intuitively. 1 = higher ability, 0 = lower ability.

Source

Santoso, P. H. et al. SPHERE: Students' performance dataset of conceptual understanding, scientific ability, and learning attitude in physics education research (PER). *Mendeley Data*, VI, (2024). doi: 10.17632/88d7m2fv7p.1.

References

Zhu, C. & Urhahne, D. Temporal stability of teachers' judgment accuracy of students' motivation, emotion, and achievement. *European Journal of Psychology of Education* 36, 319–337 (2021).

Examples

```
library(spheredata)
# Call the data from spheredata package
get("teachersjudgment")
# Open the data
teachersjudgment
```

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