

Package ‘edmdata’

July 22, 2025

Title Data Sets for Psychometric Modeling

Version 1.3.0

Description Collection of data sets from various assessments that can be used to evaluate psychometric models. These data sets have been analyzed in the following papers that introduced new methodology as part of the application section: Jimenez, A., Balamuta, J. J., & Culpepper, S. A. (2023) <[doi:10.1111/bmsp.12307](https://doi.org/10.1111/bmsp.12307)>, Culpepper, S. A., & Balamuta, J. J. (2021) <[doi:10.1080/00273171.2021.1985949](https://doi.org/10.1080/00273171.2021.1985949)>, Yinghan Chen et al. (2021) <[doi:10.1007/s11336-021-09750-9](https://doi.org/10.1007/s11336-021-09750-9)>, Yinyin Chen et al. (2020) <[doi:10.1007/s11336-019-09693-2](https://doi.org/10.1007/s11336-019-09693-2)>, Culpepper, S. A. (2019a) <[doi:10.1007/s11336-019-09683-4](https://doi.org/10.1007/s11336-019-09683-4)>, Culpepper, S. A. (2019b) <[doi:10.1007/s11336-018-9643-8](https://doi.org/10.1007/s11336-018-9643-8)>, Culpepper, S. A., & Chen, Y. (2019) <[doi:10.3102/1076998618791306](https://doi.org/10.3102/1076998618791306)>, Culpepper, S. A., & Balamuta, J. J. (2017) <[doi:10.1007/s11336-015-9484-7](https://doi.org/10.1007/s11336-015-9484-7)>, and Culpepper, S. A. (2015) <[doi:10.3102/1076998615595403](https://doi.org/10.3102/1076998615595403)>.

URL <https://tmsalab.github.io/edmdata/>,
<https://github.com/tmsalab/edmdata/>

BugReports <https://github.com/tmsalab/edmdata/issues>

Depends R (>= 4.1.0)

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items_ecpe	<i>Examination for the Certificate of Proficiency in English (ECPE) Item Responses</i>
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Description

Examination for the Certificate of Proficiency in English (ECPE) Item Responses

Usage

items_ecpe

Format

An object of class matrix (inherits from array) with 2922 rows and 28 columns.

Details

The subjects answered the following assessment items:

- item01
- item02
- item03
- item04

- item05
- item06
- item07
- item08
- item09
- item11
- item12
- item13
- item14
- item15
- item16
- item17
- item18
- item19
- item20
- item21
- item22
- item23
- item24
- item25
- item26
- item27
- item28

References

Data originated from:

- Templin, J., & Bradshaw, L. (2014). Hierarchical diagnostic classification models: A family of models for estimating and testing attribute hierarchies. *Psychometrika*, 79(2), 317–339. doi:10.1007/s1133601393620
- Templin, J., & Hoffman, L. (2013). Obtaining diagnostic classification model estimates using mplus. *Educational Measurement: Issues and Practice*, 32(2), 37–50. doi:10.1111/emip.12010

Data used in:

- Culpepper, S. A., & Chen, Y. (2019). Development and application of an exploratory reduced reparameterized unified model. *Journal of Educational and Behavioral Statistics*, 44(1), 3–24. doi:10.3102/1076998618791306

items_fractions

Fraction Subtraction and Addition Assessment Item Responses

Description

Fraction Subtraction and Addition Assessment Item Responses

Usage

items_fractions

Format

An object of class *matrix* (inherits from *array*) with 536 rows and 20 columns.

Details

The subjects answered the following assessment items:

- Item01: $\frac{5}{3} - \frac{3}{4}$
- Item02: $\frac{3}{4} - \frac{3}{8}$
- Item03: $\frac{5}{6} - \frac{1}{9}$
- Item04: $3\frac{1}{2} - 2\frac{3}{2}$
- Item05: $4\frac{3}{5} - 3\frac{4}{10}$
- Item06: $\frac{6}{7} - \frac{4}{7}$
- Item07: $3 - 2\frac{1}{5}$
- Item08: $\frac{2}{3} - \frac{2}{3}$
- Item09: $3\frac{7}{8} - 2$
- Item10: $4\frac{4}{12} - 2\frac{7}{12}$
- Item11: $4\frac{1}{3} - 2\frac{4}{3}$
- Item12: $\frac{11}{8} - \frac{1}{8}$
- Item13: $3\frac{3}{8} - 2\frac{5}{6}$
- Item14: $3\frac{4}{5} - 3\frac{2}{5}$
- Item15: $2 - \frac{1}{3}$
- Item16: $4\frac{5}{7} - 1\frac{4}{7}$
- Item17: $7\frac{3}{5} - 2\frac{4}{5}$
- Item18: $4\frac{1}{10} - 2\frac{8}{10}$
- Item19: $4 - 1\frac{4}{3}$
- Item20: $4\frac{1}{3} - 1\frac{5}{3}$

References

Data originated from:

- Tatsuoka, C. (2002). Data analytic methods for latent partially ordered classification models. *Journal of the Royal Statistical Society: Series C (Applied Statistics)*, 51(3), 337–350. doi:10.1111/14679876.00272
- Tatsuoka, K. K. (1984). Analysis of errors in fraction addition and subtraction problems (Final Report for Grant No. NIE-G-81-0002). Urbana: University of Illinois, Computer-Based Education Research Laboratory (CERL).

Data used in:

- Chen, Y., Liu, Y., Culpepper, S. A., & Chen, Y. (2021). Inferring the number of attributes for the exploratory DINA model. *Psychometrika*, 86(1), 30–64. doi:10.1007/s11336021097509
- Chen, Y., Culpepper, S. A., & Liang, F. (2020). A sparse latent class model for cognitive diagnosis. *Psychometrika*, 1–33. doi:10.1007/s11336019096932
- Culpepper, S. A. (2019). Estimating the cognitive diagnosis Q matrix with expert knowledge: Application to the fraction-subtraction dataset. *Psychometrika*, 84(2), 333–357. doi:10.1007/s1133601896438
- Culpepper, S. A., & Chen, Y. (2019). Development and application of an exploratory reduced reparameterized unified model. *Journal of Educational and Behavioral Statistics*, 44(1), 3–24. doi:10.3102/1076998618791306
- Chen, Y., Culpepper, S. A., Chen, Y., & Douglas, J. (2018). Bayesian estimation of the dina q matrix. *Psychometrika*, 83(1), 89–108. doi:10.1007/s1133601795794

items_hcp_penn_matrix *Human Connectome Project's Penn Progressive Matrices Fluid Intelligence Assessment*

Description

Trial data from Form A of an abbreviated version of the Raven's Progressive Matrices developed by Gur and colleagues (Bilker et al. 2012). Participants are presented with patterns made up of 2x2, 3x3 or 1x5 arrangements of squares, with one of the squares missing. The participant must pick one of five response choices that best fits the missing square on the pattern. The task has 24 items and 3 bonus items, arranged in order of increasing difficulty. However, the task discontinues if the participant makes 5 incorrect responses in a row.

Usage

items_hcp_penn_matrix

items_hcp_penn_matrix_missing

Format

An object of class `matrix` (inherits from `array`) with 1201 rows and 24 columns.

An object of class `matrix` (inherits from `array`) with 1201 rows and 24 columns.

Details

The subjects answered the following assessment items:

- item01
- item02
- item03
- item04
- item05
- item06
- item07
- item08
- item09
- item11
- item12
- item13
- item14
- item15
- item16
- item17
- item18
- item19
- item20
- item21
- item22
- item23
- item24

Data Cleaning

The `items_hcp_penn` data set includes $N = 1,201$ observations. However, the observation count was calculated after removing participants that did not respond to any questions (Subject ID's: 117728, 137431, 145531, 236130, and 614439). From there, we generated the `items_hcp_penn_missing` data set that retains a missing data structure after the participant makes 5 incorrect responses in a row.

References

Data originated from:

Data were provided in part by the Human Connectome Project, WU-Minn Consortium (Principal Investigators: David Van Essen and Kamil Ugurbil; 1U54MH091657) funded by the 16 NIH Institutes and Centers that support the NIH Blueprint for Neuroscience Research; and by the McDonnell Center for Systems Neuroscience at Washington University.

Data used in:

- TBA

items_matrix_reasoning

Experimental Matrix Reasoning Test Item Responses

Description

Experimental Matrix Reasoning Test Item Responses

Usage

items_matrix_reasoning

Format

An object of class `matrix` (inherits from `array`) with 400 rows and 25 columns.

Details

Items included:

- Q1
- Q2
- Q3
- Q4
- Q5
- Q6
- Q7
- Q8
- Q9
- Q10
- Q11
- Q12
- Q13

- Q14
- Q15
- Q16
- Q17
- Q18
- Q19
- Q20
- Q21
- Q22
- Q23
- Q24
- Q25

Answer coding

The subjects answered a set of assessment items seeking to determine their matrix reasoning abilities. Subjects that answered with a value between 0 to 7 were marked as incorrect. Subjects who answered a question with 10 selected the correct answer and, thus, were marked as correct.

Notes

From the OpenPsychometrics' code book that accompanied the data, they noted:

1. The possible answers were presented in two rows of four with a random order for each participant.
2. The collection of this data was of mediocre quality.

References

Data originated from:

- OpenPsychometrics. (2012). *Experimental matrix reasoning iq test*. https://openpsychometrics.org/_rawdata/IQ1.zip

Data used in:

- Chen, Y., Culpepper, S. A., & Liang, F. (2020). A sparse latent class model for cognitive diagnosis. *Psychometrika*, 1–33. [doi:10.1007/s11336019096932](https://doi.org/10.1007/s11336019096932)

`items_narcissistic_personality_inventory`*Narcissistic Personality Inventory Item Responses*

Description

Narcissistic Personality Inventory Item Responses

Usage

`items_narcissistic_personality_inventory`

Format

An object of class `matrix` (inherits from `array`) with 11243 rows and 40 columns.

Details

Items with their desired option response bolded:

- Q1
 - **Option 1:** I have a natural talent for influencing people
 - Option 2: I am not good at influencing people.
- Q2
 - **Option 1:** Modesty doesn't become me
 - Option 2: I am essentially a modest person.
- Q3
 - **Option 1:** I would do almost anything on a dare
 - Option 2: I tend to be a fairly cautious person.
- Q4
 - Option 1: When people compliment me I sometimes get embarrassed
 - **Option 2:** I know that I am good because everybody keeps telling me so.
- Q5
 - Option 1: The thought of ruling the world frightens the hell out of me
 - **Option 2:** If I ruled the world it would be a better place.
- Q6
 - **Option 1:** I can usually talk my way out of anything
 - Option 2: I try to accept the consequences of my behavior.
- Q7
 - Option 1: I prefer to blend in with the crowd
 - **Option 2:** I like to be the center of attention.
- Q8

- **Option 1:** I will be a success
 - Option 2: I am not too concerned about success.
- Q9
 - Option 1: I am no better or worse than most people
 - **Option 2:** I think I am a special person.
- Q10
 - Option 1: I am not sure if I would make a good leader
 - **Option 2:** I see myself as a good leader.
- Q11
 - **Option 1:** I am assertive
 - Option 2: I wish I were more assertive.
- Q12
 - **Option 1:** I like to have authority over other people
 - Option 2: I don't mind following orders.
- Q13
 - **Option 1:** I find it easy to manipulate people
 - Option 2: I don't like it when I find myself manipulating people.
- Q14
 - **Option 1:** I insist upon getting the respect that is due me
 - Option 2: I usually get the respect that I deserve.
- Q15
 - Option 1: I don't particularly like to show off my body
 - **Option 2:** I like to show off my body.
- Q16
 - **Option 1:** I can read people like a book
 - Option 2: People are sometimes hard to understand.
- Q17
 - Option 1: If I feel competent I am willing to take responsibility for making decisions
 - **Option 2:** I like to take responsibility for making decisions.
- Q18
 - Option 1: I just want to be reasonably happy
 - **Option 2:** I want to amount to something in the eyes of the world.
- Q19
 - Option 1: My body is nothing special
 - **Option 2:** I like to look at my body.
- Q20
 - Option 1: I try not to be a show off
 - **Option 2:** I will usually show off if I get the chance.
- Q21

- **Option 1:** I always know what I am doing
 - Option 2: Sometimes I am not sure of what I am doing.
- Q22
 - Option 1: I sometimes depend on people to get things done
 - **Option 2:** I rarely depend on anyone else to get things done.
- Q23
 - Option 1: Sometimes I tell good stories
 - **Option 2:** Everybody likes to hear my stories.
- Q24
 - **Option 1:** I expect a great deal from other people
 - Option 2: I like to do things for other people.
- Q25
 - **Option 1:** I will never be satisfied until I get all that I deserve
 - Option 2: I take my satisfactions as they come.
- Q26
 - Option 1: Compliments embarrass me
 - **Option 2:** I like to be complimented.
- Q27
 - **Option 1:** I have a strong will to power
 - Option 2: Power for its own sake doesn't interest me.
- Q28
 - Option 1: I don't care about new fads and fashions
 - **Option 2:** I like to start new fads and fashions.
- Q29
 - **Option 1:** I like to look at myself in the mirror
 - Option 2: I am not particularly interested in looking at myself in the mirror.
- Q30
 - **Option 1:** I really like to be the center of attention
 - Option 2: It makes me uncomfortable to be the center of attention.
- Q31
 - **Option 1:** I can live my life in any way I want to
 - Option 2: People can't always live their lives in terms of what they want.
- Q32
 - Option 1: Being an authority doesn't mean that much to me
 - **Option 2:** People always seem to recognize my authority.
- Q33
 - **Option 1:** I would prefer to be a leader
 - Option 2: It makes little difference to me whether I am a leader or not.
- Q34

- **Option 1:** I am going to be a great person
- Option 2: I hope I am going to be successful.
- Q35
 - Option 1: People sometimes believe what I tell them
 - **Option 2:** I can make anybody believe anything I want them to.
- Q36
 - **Option 1:** I am a born leader
 - Option 2: Leadership is a quality that takes a long time to develop.
- Q37
 - **Option 1:** I wish somebody would someday write my biography
 - Option 2: I don't like people to pry into my life for any reason.
- Q38
 - **Option 1:** I get upset when people don't notice how I look when I go out in public
 - Option 2: I don't mind blending into the crowd when I go out in public.
- Q39
 - **Option 1:** I am more capable than other people
 - Option 2: There is a lot that I can learn from other people.
- Q40
 - Option 1: I am much like everybody else
 - **Option 2:** I am an extraordinary person.

Data pre-processing

We have applied list-wise deletion during pre-processing to remove any observations with missing values from the data set.

Answer coding

The subjects answered a set of assessment items seeking to determine the level of anxiety. Answers given in **bold** represent the desired response. If a subject matched this response, they were given a 1 inside of the item matrix, otherwise they received a zero.

References

Assessment Design:

- Raskin, R., & Terry, H. (1988). A principal-components analysis of the narcissistic personality inventory and further evidence of its construct validity. *Journal of Personality and Social Psychology*, 54(5), 890. doi:10.1037/00223514.54.5.890

Data originated from:

- OpenPsychometrics. 2013. *Narcissistic Personality Inventory*. https://openpsychometrics.org/_rawdata/NPI.zip.

Data used in:

- TBA

items_ordered_eclsk_atl

Subset of Early Childhood Longitudinal Study, Kindergarten (ECLS-K)'s Approaches to Learning Item Responses

Description

Subset of Early Childhood Longitudinal Study, Kindergarten (ECLS-K)'s Approaches to Learning Item Responses

Usage

```
items_ordered_eclsk_atl
```

Format

An object of class `matrix` (inherits from `array`) with 13354 rows and 12 columns.

Details

Items were split between being answered by **Parents** and **Teachers**.

- **Parents:**

- P4SRS10: Keep working at something until he or she is finished?
- P4SRS13: Show interest in a variety of things?
- P4SRS15: Concentrate on a task and ignore distractions?
- P4SRS18: Help with chores?
- P4SRS22: Eager to learn new things?
- P4SRS24: Creative in work or in play?

- **Teachers:**

- T4SRS11: Keeps belongings organized.
- T4SRS14: Shows eagerness to learn new things.
- T4SRS15: Works independently.
- T4SRS21: Easily adapts to changes in routine.
- T4SRS23: Persists in completing tasks.
- T4SRS24: Pays attention well.

Data pre-processing

The Early Childhood Longitudinal Study, Kindergarten (ECLS-K) has been subset down both the number of observations and variables. In particular, only observations without any missing values from a set of reduced variables – given above – are included. If additional data is required, please visit the data download page found in the reference section.

Answer coding

Parents and teachers each answered a set of survey items involving a likert scale that ranged from "1 = never" to "4 = very often" regarding the subject. Within the teacher responses, they also had the option of marking "-7 = no opportunity to observe" option, which was treated as a missing observation. To align with C++, we perform a index shift backward of 1 and, thus, make the scale "0=never" to "3=very often".

References

Data originated from:

- NCES. (2010). *Early childhood longitudinal study, kindergarten class of 1998-99 (ecls-k) kindergarten through fifth grade approaches to learning and self-description questionnaire (sdq) items and public-use data files*. <https://nces.ed.gov/pubsearch/pubsinfo.asp?pubid=2010070>

Data used in:

- Culpepper, S. (2019). An exploratory diagnostic model for ordinal responses with binary attributes: Identifiability and estimation. *Psychometrika*, 84(4), 921–940. doi:10.1007/s11336-019096834

items_ordered_pisa12_us_vignette

*Programme for International Student Assessment (PISA) 2012 U.S.
Student Questionnaire Problem-Solving Vignettes*

Description

Programme for International Student Assessment (PISA) 2012 U.S. Student Questionnaire Problem-Solving Vignettes

Usage

items_ordered_pisa12_us_vignette

Format

An object of class matrix (inherits from array) with 3075 rows and 12 columns.

Details

Obtained from the PISA 2012 questionnaire responses given to 15-year olds, we selected 12 items under three vignettes and four item stems to measure problem-solving strategies applied by students.

- Vignette (a):
 - Suppose that you have been sending text messages from your mobile phone for several weeks. Today, however, you can't send text messages. You want to try to solve the problem.

- * **ST96Q01**: I press every button possible to find out what is wrong.
- * **ST96Q02**: I think about what might have caused the problem and what I can do to solve it.
- * **ST96Q03**: I read the manual.
- * **ST96Q05**: I ask a friend for help.
- Vignette (b):
 - Suppose that you are planning a trip to the zoo with your brother. You don't know which route to take to get there.
 - * **ST101Q01**: I read the zoo brochure to see if it says how to get there.
 - * **ST101Q02**: I study a map and work out the best route.
 - * **ST101Q03**: I leave it to my brother to worry about how to get there.
 - * **ST101Q05**: I know roughly where it is, so I suggest we just start driving.
- Vignette (c):
 - Suppose that you arrive at the train station. There is a ticket machine that you have never used before. You want to buy a ticket.
 - * **ST104Q01**: I check how similar it is to other ticket machines I have used.
 - * **ST104Q04**: I try out all the buttons to see what happens.
 - * **ST104Q05**: I ask someone for help.
 - * **ST104Q06**: I try to find a ticket office at the station to buy a ticket.

Answer Coding

All items were reverse-coded such that responses categories begin with negative responses at 0 and go to 3 for a positive responses.

- **0**: I would definitely not do this.
- **1**: I would probably not do this.
- **2**: I would probably do this.
- **3**: I would definitely do this.

References

Assessment Design:

- PISA Test Overview: <https://www.oecd.org/pisa/aboutpisa.html>
- PISA 2012 Mathematics Items: https://www.oecd.org/pisa/test/PISA%202012%20items%20for%20release_ENGLISH.pdf

Data used in:

- Culpepper, S. A., & Balamuta, J. J. (2021). Inferring latent structure in polytomous data with a higher-order diagnostic model. *Multivariate Behavioral Research*, 1–19. doi:10.1080/00273171.2021.1985949

items_ordered_pswc_hw *Calculus-based probability and statistics course homework problems*

Description

Calculus-based probability and statistics course homework problems

Usage

items_ordered_pswc_hw

Format

An object of class *matrix* (inherits from *array*) with 288 rows and 29 columns.

Details

Data set contains the subject's responses to calculus-based probability and statistics course homework problems.

- Item01: Subject's Response to Item 1.
- Item02: Subject's Response to Item 2.
- Item03: Subject's Response to Item 3.
- Item05: Subject's Response to Item 5.
- Item06: Subject's Response to Item 6.
- Item07: Subject's Response to Item 7.
- Item08: Subject's Response to Item 8.
- Item09: Subject's Response to Item 9.
- Item10: Subject's Response to Item 10.
- Item11: Subject's Response to Item 11.
- Item12: Subject's Response to Item 12.
- Item13: Subject's Response to Item 13.
- Item14: Subject's Response to Item 14.
- Item15: Subject's Response to Item 15.
- Item16: Subject's Response to Item 16.
- Item17: Subject's Response to Item 17.
- Item18: Subject's Response to Item 18.
- Item19: Subject's Response to Item 19.
- Item21: Subject's Response to Item 21.
- Item22: Subject's Response to Item 22.
- Item23: Subject's Response to Item 23.

- Item24: Subject's Response to Item 24.
- Item25: Subject's Response to Item 25.
- Item26: Subject's Response to Item 26.
- Item27: Subject's Response to Item 27.
- Item29: Subject's Response to Item 29.
- Item30: Subject's Response to Item 30.
- Item32: Subject's Response to Item 32.
- Item34: Subject's Response to Item 34.

References

Data used in:

- Jimenez, A., Balamuta, J. J., & Culpepper, S. A. (2023). A sequential exploratory diagnostic model using a Pólya-gamma data augmentation strategy. *British Journal of Mathematical and Statistical Psychology*, 76, 513–538. doi:10.1111/bmsp.12307

Data originated from:

- Culpepper, S. A. (2014). If at first you don't succeed, try, try again: Applications of sequential IRT models to cognitive assessments. *Applied Psychological Measurement*, 38(8), 632–644. doi:10.1177/0146621614536464

items_ordered_timss15_background

*Trends in International Mathematics and Science Study 2015 (TIMSS)
Grade 8 Student Background Survey Item Responses*

Description

Trends in International Mathematics and Science Study 2015 (TIMSS) Grade 8 Student Background Survey Item Responses

Usage

items_ordered_timss15_background

Format

An object of class *matrix* (inherits from *array*) with 9672 rows and 16 columns.

Details

From the school background data file, we selected 16 items under two distinct item stems that sought to measure students' school experiences using a four-level likert-scale.

- What do you think about your school? Tell me how much you agree with these statements:
 - "BSBG15A": I like being in school
 - "BSBG15B": I feel safe when I am in school
 - "BSBG15C": I feel like I belong at this school
 - "BSBG15D": I like to see my classmates at school.
 - "BSBG15E": Teachers at my school are fair to me.
 - "BSBG15F": I am proud to go to this school.
 - "BSBG15G": I learn a lot in school.
- During this year, how often have the following things happened to you at school?
 - "BSBG16A": Made fun of me or called me names.
 - "BSBG16B": Left me out of their games or activities.
 - "BSBG16C": Spread lies about me.
 - "BSBG16D": Stole something from me.
 - "BSBG16E": Hit or hurt me (e.g. shoving, hitting, kicking).
 - "BSBG16F": Made me do things I didn't want to.
 - "BSBG16G": Shared embarrassing information about me.
 - "BSBG16H": Posted embarrassing things about me online.
 - "BSBG16I": Threatened me.

Answer Coding

Items 8 through 16 were reverse-coded.

References

Data originated from:

- Trends in International Mathematics and Science Study 2015 (TIMSS) Grade 8 Student Background Survey Item Responses (Mullis et al., 2016).

Data used in:

- TBA

items_pisa12_us_math *Programme for International Student Assessment (PISA) 2012 US Math Assessment*

Description

Programme for International Student Assessment (PISA) 2012 US Math Assessment

Usage

items_pisa12_us_math

Format

An object of class `matrix` (inherits from `array`) with 4978 rows and 76 columns.

Details

PISA assessment booklets have a spiral pattern. As a result, we've opted to re-order the data by booklet ID

Items alongside of the problem name:

- pm00fq01: P2012 Apartment Purchase Q1
- pm00gq01: P2012 An Advertising Column Q1
- pm00kq02: P2012 Wheelchair Basketball Q2
- pm033q01: P2000 A View with a Room Q1
- pm034q01t: P2000 Bricks Q1
- pm155q01: P2000 Pop Pyramids Q1
- pm155q04t: P2000 Pop Pyramids Q4
- pm192q01t: P2000 Containers Q1
- pm273q01t: P2000 Pipelines Q1
- pm305q01: P2000 Map Q1
- pm406q01: P2003 Running Tracks Q1
- pm406q02: P2003 Running Tracks Q2
- pm408q01t: P2003 Lotteries Q1
- pm411q01: P2003 Diving Q1
- pm411q02: P2003 Diving Q2
- pm420q01t: P2003 Transport Q1
- pm423q01: P2003 Tossing Coins Q1
- pm442q02: P2003 Braille Q2
- pm446q01: P2003 The Thermometer Cricket Q1

- pm446q02: P2003 The Thermometer Cricket Q2
- pm447q01: P2003 Tile Arrangement Q1
- pm464q01t: P2003 The Fence Q1
- pm474q01: P2003 Running Time Q1
- pm496q01t: P2003 Cash Withdrawal Q1
- pm496q02: P2003 Cash Withdrawal Q2
- pm559q01: P2003 Telephone Rates Q1
- pm564q01: P2003 Chair Lift Q1
- pm564q02: P2003 Chair Lift Q2
- pm571q01: P2003 Stop the Car Q1
- pm603q01t: P2003 Number Check Q1
- pm800q01: P2003 Computer Game Q1
- pm803q01t: P2003 Labels Q1
- pm828q01: P2003 Carbon Dioxide Q1
- pm828q02: P2003 Carbon Dioxide Q2
- pm828q03: P2003 Carbon Dioxide Q3
- pm903q03: P2012 Drip Rate Q3
- pm905q01t: P2012 Tennis Balls Q1
- pm905q02: P2012 Tennis Balls Q2
- pm906q01: P2012 Crazy Ants Q1
- pm909q01: P2012 Speeding Fines Q1
- pm909q02: P2012 Speeding Fines Q2
- pm909q03: P2012 Speeding Fines Q3
- pm915q01: P2012 Carbon Tax Q1
- pm915q02: P2012 Carbon Tax Q2
- pm918q01: P2012 Charts Q1
- pm918q02: P2012 Charts Q2
- pm918q05: P2012 Charts Q5
- pm919q01: P2012 Zs Fan Merchandise Q1
- pm919q02: P2012 Zs Fan Merchandise Q2
- pm923q01: P2012 Sailing Ships Q1
- pm923q03: P2012 Sailing Ships Q3
- pm923q04: P2012 Sailing Ships Q4
- pm924q02: P2012 Sauce Q2
- pm943q01: P2012 Arches Q1
- pm943q02: P2012 Arches Q2
- pm949q01t: P2012 Roof Truss Design Q1

- pm949q02t: P2012 Roof Truss Design Q2
- pm953q02: P2012 Flu Test Q2
- pm953q03: P2012 Flu Test Q3
- pm954q01: P2012 Medicine Doses Q1
- pm954q02: P2012 Medicine Doses Q2
- pm954q04: P2012 Medicine Doses Q4
- pm955q01: P2012 Migration Q1
- pm955q02: P2012 Migration Q2
- pm982q01: P2012 Employment Data Q1
- pm982q02: P2012 Employment Data Q2
- pm982q03t: P2012 Employment Data Q3
- pm982q04: P2012 Employment Data Q4
- pm992q01: P2012 Spacers Q1
- pm992q02: P2012 Spacers Q2
- pm992q03: P2012 Spacers Q3
- pm995q01: P2012 Revolving Door Q1
- pm995q02: P2012 Revolving Door Q2
- pm995q03: P2012 Revolving Door Q3
- pm998q02: P2012 Bike Rental Q2
- pm998q04t: P2012 Bike Rental Q4

Answer coding

The subjects answered a set of assessment items seeking to determine their knowledge of mathematics. The original PISA 2012 data set included variables that had problems with the following labels:

- One level:
 - "N/A"
- Four Levels:
 - "Score 0"
 - "Score 1"
 - "Score 7: N/A"
 - "Score 8: Not Attempted"
- Five Levels:
 - "Score 0"
 - "Score 1"
 - "Score 2"
 - "Score 7: N/A"
 - "Score 8: Not Attempted"

Note, this data set includes items with four levels only. Further, items are coded with Score 0 as 0, Score 1 as 1, Score 7: N/A as NA, and Score 8: Not Attempted as 0.

References

Assessment Design:

- PISA Test Overview: <https://www.oecd.org/pisa/aboutpisa.html>
- PISA 2012 Mathematics Items: https://www.oecd.org/pisa/test/PISA%202012%20items%20for%20release_ENGLISH.pdf

Data originated from:

- Paul Bailey, Ahmad Emad, Huade Huo, Michael Lee, Yuqi Liao, Alex Lishinski, Trang Nguyen, Qingshu Xie, Jiao Yu, Ting Zhang, Eric Buehler, Jeppe Bundsgaard, Ren C'deBaca and Anders Astrup Christensen (2021). EdSurvey: Analysis of NCES Education Survey and Assessment Data. R package version 2.7.0. <https://CRAN.R-project.org/package=EdSurvey>

Data used in:

- TBA

items_probability_part_one_full

Elementary Probability Theory Assessment Item Responses

Description

Elementary Probability Theory Assessment Item Responses

Usage

items_probability_part_one_full

items_probability_part_one_reduced

Format

An object of class `matrix` (inherits from `array`) with 504 rows and 12 columns.

An object of class `matrix` (inherits from `array`) with 431 rows and 12 columns.

Details

Questions wording and answers are from the `pks` package documentation.

Items with their desired responses bolded:

- b101: A box contains 30 marbles in the following colors: 8 red, 10 black, 12 yellow. What is the probability that a randomly drawn marble is yellow? **(0.40)**
- b102: A bag contains 5-cent, 10-cent, and 20-cent coins. The probability of drawing a 5-cent coin is 0.35, that of drawing a 10-cent coin is 0.25, and that of drawing a 20-cent coin is 0.40. What is the probability that the coin randomly drawn is not a 5-cent coin? **(0.65)**

- b103: A bag contains 5-cent, 10-cent, and 20-cent coins. The probability of drawing a 5-cent coin is 0.20, that of drawing a 10-cent coin is 0.45, and that of drawing a 20-cent coin is 0.35. What is the probability that the coin randomly drawn is a 5-cent coin or a 20-cent coin? **(0.55)**
- b104: In a school, 40\ the pupils are right-handed. Suppose that gender and handedness are independent. What is the probability of randomly selecting a right-handed boy? **(0.32)**
- b105: Given a standard deck containing 32 different cards, what is the probability of not drawing a heart? **(0.75)**
- b106: A box contains 20 marbles in the following colors: 4 white, 14 green, 2 red. What is the probability that a randomly drawn marble is not white? **(0.80)**
- b107: A box contains 10 marbles in the following colors: 2 yellow, 5 blue, 3 red. What is the probability that a randomly drawn marble is yellow or blue? **(0.70)**
- b108: What is the probability of obtaining an even number by throwing a dice? **(0.50)**
- b109: Given a standard deck containing 32 different cards, what is the probability of drawing a 4 in a black suit? **(Responses that round to 0.06 were considered correct.)**
- b110: A box contains marbles that are red or yellow, small or large. The probability of drawing a red marble is 0.70 (**lab: 0.30**), the probability of drawing a small marble is 0.40. Suppose that the color of the marbles is independent of their size. What is the probability of randomly drawing a small marble that is not red? **(0.12, lab: 0.28)**
- b111: In a garage there are 50 cars. 20 are black and 10 are diesel powered. Suppose that the color of the cars is independent of the kind of fuel. What is the probability that a randomly selected car is not black and it is diesel powered? **(0.12)**
- b112: A box contains 20 marbles. 10 marbles are red, 6 are yellow and 4 are black. 12 marbles are small and 8 are large. Suppose that the color of the marbles is independent of their size. What is the probability of randomly drawing a small marble that is yellow or red? **(0.48)**

Data Cleaning

The items_probability_part_one_full data set includes $N = 504$ observations used in Chen et al. (2021). However, the observations contained missing trial data as NA. Excluding the missing response values from part one respondents yields $N = 431$. The data set with reduced items is given in items_probability_part_one_reduced.

References

Data originated from:

- Heller, J., & Wickelmaier, F. (2013). Minimum discrepancy estimation in probabilistic knowledge structures. *Electronic Notes in Discrete Mathematics*, 42, 49–56. doi:10.1016/j.endm.2013.05.145

Data used in:

- Chen, Yinghan, Liu, Y., Culpepper, S. A., & Chen, Y. (2021). Inferring the number of attributes for the exploratory DINA model. *Psychometrika*, 86(1), 30–64. doi:10.1007/s11336-021097509

items_revised_psvtr	<i>Revised PSVT:R Item Responses</i>
---------------------	--------------------------------------

Description

Revised PSVT:R Item Responses

Usage

items_revised_psvtr

Format

An object of class *matrix* (inherits from *array*) with 516 rows and 30 columns.

Details

Data set contains the subject's responses to Revised PSVT:R items. Correct answers are denoted by 1 and incorrect answers are denoted by 0.

- Item01: Subject's Response to Item 1.
- Item02: Subject's Response to Item 2.
- Item03: Subject's Response to Item 3.
- Item04: Subject's Response to Item 4.
- Item05: Subject's Response to Item 5.
- Item06: Subject's Response to Item 6.
- Item07: Subject's Response to Item 7.
- Item08: Subject's Response to Item 8.
- Item09: Subject's Response to Item 9.
- Item10: Subject's Response to Item 10.
- Item11: Subject's Response to Item 11.
- Item12: Subject's Response to Item 12.
- Item13: Subject's Response to Item 13.
- Item14: Subject's Response to Item 14.
- Item15: Subject's Response to Item 15.
- Item16: Subject's Response to Item 16.
- Item17: Subject's Response to Item 17.
- Item18: Subject's Response to Item 18.
- Item19: Subject's Response to Item 19.
- Item20: Subject's Response to Item 20.
- Item21: Subject's Response to Item 21.

- Item22: Subject's Response to Item 22.
- Item23: Subject's Response to Item 23.
- Item24: Subject's Response to Item 24.
- Item25: Subject's Response to Item 25.
- Item26: Subject's Response to Item 26.
- Item27: Subject's Response to Item 27.
- Item28: Subject's Response to Item 28.
- Item29: Subject's Response to Item 29.
- Item30: Subject's Response to Item 30.

References

Assessment Design:

- Yoon, S. Y. (2011). *Psychometric properties of the revised purdue spatial visualization tests: Visualization of rotations (the revised psvt: R)*. Purdue University.

Data originated from:

- Culpepper, S. A., & Balamuta, J. J. (2017). A Hierarchical Model for Accuracy and Choice on Standardized Tests. *Psychometrika*, 82(3), 820–845. doi:10.1007/s1133601594847

Data used in:

- Culpepper, S. A. (2015). Bayesian estimation of the dina model with gibbs sampling. *Journal of Educational and Behavioral Statistics*, 40(5), 454–476. doi:10.3102/1076998615595403
- Culpepper, S. A., & Balamuta, J. J. (2017). A Hierarchical Model for Accuracy and Choice on Standardized Tests. *Psychometrika*, 82(3), 820–845. doi:10.1007/s1133601594847

items_spm_ls	<i>Last Series of the Standard Progressive Matrices (SPM-LS) Item Responses</i>
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Description

Last Series of the Standard Progressive Matrices (SPM-LS) Item Responses

Usage

items_spm_ls

Format

An object of class `matrix` (inherits from `array`) with 499 rows and 12 columns.

Details

Items with the correct answer response based off of Table 9 of the Robitzsch (2020) pre-print paper.

- SPM1: **7**
- SPM2: **6**
- SPM3: **8**
- SPM4: **2**
- SPM5: **1**
- SPM6: **5**
- SPM7: **1**
- SPM8: **6**
- SPM9: **3**
- SPM10: **2**
- SPM11: **4**
- SPM12: **5**

Answer coding

The subjects answered a set of assessment items seeking to determine the level of matrix reasoning. Answers given in **bold** represent the desired response. If a subject matched this response, they were given a 1 inside of the item matrix, otherwise they received a zero.

References

Assessment Design:

- Raven, J. C. (1941). Standardization of progressive matrices, 1938. *British Journal of Medical Psychology*, 19(1), 137–150. doi:10.1111/j.20448341.1941.tb00316.x

Data originated from:

- Myszkowski, N., & Storme, M. (2018). A snapshot of g? Binary and polytomous item-response theory investigations of the last series of the standard progressive matrices (spm-ls). *Intelligence*, 68, 109–116. doi:10.1016/j.intell.2018.03.010
- Robitzsch, A. (2020). Regularized latent class analysis for polytomous item responses: An application to spm-ls data. *Preprint*. doi:10.20944/preprints202007.0269.v1

Data used in:

- TBA

`items_taylor_manifest_anxiety_scale`*Taylor Manifest Anxiety Scale Item Responses*

Description

Taylor Manifest Anxiety Scale Item Responses

Usage

```
items_taylor_manifest_anxiety_scale
```

Format

An object of class `matrix` (inherits from `array`) with 4468 rows and 50 columns.

Details

Questions alongside of their correct answer is based off of Table 1 of the Taylor (1953) paper.

Items with their desired response bolded:

- Q1: I do not tire quickly. **(False)**
- Q2: I am troubled by attacks of nausea. **(True)**
- Q3: I believe I am no more nervous than most others. **(False)**
- Q4: I have very few headaches. **(False)**
- Q5: I work under a great deal of tension. **(True)**
- Q6: I cannot keep my mind on one thing. **(True)**
- Q7: I worry over money and business. **(True)**
- Q8: I frequently notice my hand shakes when I try to do something. **(True)**
- Q9: I blush no more often than others. **(False)**
- Q10: I have diarrhea once a month or more. **(True)**
- Q11: I worry quite a bit over possible misfortunes. **(True)**
- Q12: I practically never blush. **(False)**
- Q13: I am often afraid that I am going to blush. **(True)**
- Q14: I have nightmares every few nights. **(True)**
- Q15: My hands and feet are usually warm. **(False)**
- Q16: I sweat very easily even on cool days. **(True)**
- Q17: Sometimes when embarrassed, I break out in a sweat. **(True)**
- Q18: I hardly ever notice my heart pounding and I am seldom short of breath. **(False)**
- Q19: I feel hungry almost all the time. **(True)**
- Q20: I am very seldom troubled by constipation. **(False)**

- Q21: I have a great deal of stomach trouble. **(True)**
- Q22: I have had periods in which I lost sleep over worry. **(True)**
- Q23: My sleep is fitful and disturbed. **(True)**
- Q24: I dream frequently about things that are best kept to myself. **(True)**
- Q25: I am easily embarrassed. **(True)**
- Q26: I am more sensitive than most other people. **(True)**
- Q27: I frequently find myself worrying about something. **(True)**
- Q28: I wish I could be as happy as others seem to be. **(True)**
- Q29: I am usually calm and not easily upset. **(False)**
- Q30: I cry easily. **(True)**
- Q31: I feel anxiety about something or someone almost all the time. **(True)**
- Q32: I am happy most of the time. **(False)**
- Q33: It makes me nervous to have to wait. **(True)**
- Q34: I have periods of such great restlessness that I cannot sit long in a chair. **(True)**
- Q35: Sometimes I become so excited that I find it hard to get to sleep. **(True)**
- Q36: I have sometimes felt that difficulties were piling up so high that I could not overcome them. **(True)**
- Q37: I must admit that I have at times been worried beyond reason over something that really did not matter. **(True)**
- Q38: I have very few fears compared to my friends. **(False)**
- Q39: I have been afraid of things or people that I know could not hurt me. **(True)**
- Q40: I certainly feel useless at times. **(True)**
- Q41: I find it hard to keep my mind on a task or job. **(True)**
- Q42: I am usually self-conscious. **(True)**
- Q43: I am inclined to take things hard. **(True)**
- Q44: I am a high-strung person. **(True)**
- Q45: Life is a trial for me much of the time. **(True)**
- Q46: At times I think I am no good at all. **(True)**
- Q47: I am certainly lacking in self-confidence. **(True)**
- Q48: I sometimes feel that I am about to go to pieces. **(True)**
- Q49: I shrink from facing crisis of difficulty. **(True)**
- Q50: I am entirely self-confident. **(False)**

Data pre-processing

We have applied list-wise deletion during pre-processing to remove any observations with missing values from the data set.

Answer coding

The subjects answered a set of assessment items seeking to determine the level of anxiety. Answers given in **bold** represent the desired response. If a subject matched this response, they were given a 1 inside of the item matrix, otherwise they received a zero.

References

Assessment Design:

- Taylor, J. A. (1953). *A personality scale of manifest anxiety*. The Journal of Abnormal and Social Psychology, 48(2), 285–290. doi:10.1037/h0056264.

Data originated from:

- OpenPsychometrics. 2012. *Taylor Manifest Anxiety Scale*. https://openpsychometrics.org/_rawdata/TMA.zip.

Data used in:

- TBA

qmatrix_ecpe	<i>Examination for the Certificate of Proficiency in English (ECPE) Expert-Derived Q matrix</i>
--------------	---

Description

Examination for the Certificate of Proficiency in English (ECPE) Expert-Derived Q matrix

Usage

qmatrix_ecpe

Format

An object of class `q_matrix` (inherits from `matrix`) with 28 rows and 3 columns.

Details

Each entry in the matrix is either 1, if the item uses the skill, or 0, if the item does not use the skill. The skills identified by this matrix are:

- skill1: Morphosyntactic rules
- skill2: Cohesive rules
- skill3: Lexical rules

The subjects answered the following assessment items:

- item01

- item02
- item03
- item04
- item05
- item06
- item07
- item08
- item09
- item11
- item12
- item13
- item14
- item15
- item16
- item17
- item18
- item19
- item20
- item21
- item22
- item23
- item24
- item25
- item26
- item27
- item28

References

Data originated from:

- Templin, J., & Bradshaw, L. (2014). Hierarchical diagnostic classification models: A family of models for estimating and testing attribute hierarchies. *Psychometrika*, 79(2), 317–339. doi:10.1007/s1133601393620
- Templin, J., & Hoffman, L. (2013). Obtaining diagnostic classification model estimates using mplus. *Educational Measurement: Issues and Practice*, 32(2), 37–50. doi:10.1111/emip.12010

Data used in:

- Culpepper, S. A., & Chen, Y. (2019). Development and application of an exploratory reduced reparameterized unified model. *Journal of Educational and Behavioral Statistics*, 44(1), 3–24. doi:10.3102/1076998618791306

qmatrix_fractions	<i>Fraction Subtraction and Addition Assessment Expert-Derived Q Matrix</i>
-------------------	---

Description

Fraction Subtraction and Addition Assessment Expert-Derived Q Matrix

Usage

qmatrix_fractions

Format

An object of class `matrix` (inherits from `array`) with 20 rows and 8 columns.

Details

Each entry in the matrix is either 1, if the Item uses the Trait, or 0, if the Item does not use the Trait. The traits identified by this matrix are:

- Trait1: Convert a whole number to a fraction,
- Trait2: Separate a whole number from fraction,
- Trait3: Simplify before subtraction,
- Trait4: Find a common denominator,
- Trait5: Borrow from the whole number part,
- Trait6: Column borrow to subtract the second numerator from the first,
- Trait7: Subtract numerators,
- Trait8: Reduce answers to simplest form.

The subjects answered the following assessment items:

- Item01: $\frac{5}{3} - \frac{3}{4}$
- Item02: $\frac{3}{4} - \frac{3}{8}$
- Item03: $\frac{5}{6} - \frac{1}{9}$
- Item04: $3\frac{1}{2} - 2\frac{3}{2}$
- Item05: $4\frac{3}{5} - 3\frac{4}{10}$
- Item06: $\frac{6}{7} - \frac{4}{7}$
- Item07: $3 - 2\frac{1}{5}$
- Item08: $\frac{2}{3} - \frac{2}{3}$
- Item09: $3\frac{7}{8} - 2$
- Item10: $4\frac{4}{12} - 2\frac{7}{12}$
- Item11: $4\frac{1}{3} - 2\frac{4}{3}$

- Item12: $\frac{11}{8} - \frac{1}{8}$
- Item13: $3\frac{3}{8} - 2\frac{5}{6}$
- Item14: $3\frac{4}{5} - 3\frac{2}{5}$
- Item15: $2 - \frac{1}{3}$
- Item16: $4\frac{5}{7} - 1\frac{4}{7}$
- Item17: $7\frac{3}{5} - 2\frac{4}{5}$
- Item18: $4\frac{1}{10} - 2\frac{8}{10}$
- Item19: $4 - 1\frac{4}{3}$
- Item20: $4\frac{1}{3} - 1\frac{5}{3}$

References

Data originated from:

- Tatsuoaka, C. (2002). Data analytic methods for latent partially ordered classification models. *Journal of the Royal Statistical Society: Series C (Applied Statistics)*, 51(3), 337–350. doi:10.1111/14679876.00272
- Tatsuoaka, K. K. (1984). Analysis of errors in fraction addition and subtraction problems (Final Report for Grant No. NIE-G-81-0002). Urbana: University of Illinois, Computer-Based Education Research Laboratory (CERL).

Data used in:

- Chen, Y., Liu, Y., Culpepper, S. A., & Chen, Y. (2021). Inferring the number of attributes for the exploratory DINA model. *Psychometrika*, 86(1), 30–64. doi:10.1007/s11336021097509
- Chen, Y., Culpepper, S. A., & Liang, F. (2020). A sparse latent class model for cognitive diagnosis. *Psychometrika*, 1–33. doi:10.1007/s11336019096932
- Culpepper, S. A. (2019). Estimating the cognitive diagnosis Q matrix with expert knowledge: Application to the fraction-subtraction dataset. *Psychometrika*, 84(2), 333–357. doi:10.1007/s1133601896438
- Culpepper, S. A., & Chen, Y. (2019). Development and application of an exploratory reduced reparameterized unified model. *Journal of Educational and Behavioral Statistics*, 44(1), 3–24. doi:10.3102/1076998618791306
- Chen, Y., Culpepper, S. A., Chen, Y., & Douglas, J. (2018). Bayesian estimation of the dina q matrix. *Psychometrika*, 83(1), 89–108. doi:10.1007/s1133601795794

qmatrix_oracle

Oracle Q Matrices

Description

Pre-generated identified Q matrices used in simulation studies to verify recovery.

Format

A matrix with varying numbers of traits (K) and items (J).

Specifically:

- qmatrix_oracle_k2_j12: 12 items and 2 traits.
- qmatrix_oracle_k3_j20: 20 items and 3 traits.
- qmatrix_oracle_k4_j20: 20 items and 4 traits.
- qmatrix_oracle_k5_j30: 30 items and 5 traits.

Details

Each entry in the matrix is either 1, if the item uses the skill, or 0, if the item does not use the skill.

qmatrix_probability_part_one

Elementary Probability Theory Assessment Expert-Derived Q Matrix

Description

Elementary Probability Theory Assessment Expert-Derived Q Matrix

Usage

qmatrix_probability_part_one

Format

An object of class `matrix` (inherits from `array`) with 12 rows and 4 columns.

Details

Each entry in the matrix is either 1, if the item uses the trait, or 0, if the item does not use the trait.
The traits identified by this `matrix` are:

- `cp`: the probability of the complement of an event
- `id`: two independent events
- `pb`: probability of an event
- `un`: union of two disjoint events

For a detailed overview of items, please see [items_probability_part_one_full](#) or [items_probability_part_one_reduced](#).

Identifiability

Note, the expert supplied Q-matrix is *not* strictly identified. Though, the expert matrix is generically identified.

References

Data originated from:

- Heller, J., & Wickelmaier, F. (2013). Minimum discrepancy estimation in probabilistic knowledge structures. *Electronic Notes in Discrete Mathematics*, 42, 49–56. doi:10.1016/j.endm.2013.05.145

Data used in:

- Chen, Yinghan, Liu, Y., Culpepper, S. A., & Chen, Y. (2021). Inferring the number of attributes for the exploratory DINA model. *Psychometrika*, 86(1), 30–64. doi:10.1007/s11336-021097509

strategy_oracle

Strategy Oracle Sets

Description

Pre-generated strategy matrices used in simulation studies to verify recovery.

Format

An array with varying numbers of items (J), traits (K), and strategies (S).

Specifically:

- strategy_oracle_k3_j20_s2: 20 items, 3 traits, and 2 strategies.
- strategy_oracle_k3_j30_s2: 30 items, 3 traits, and 2 strategies.
- strategy_oracle_k3_j40_s2: 40 items, 3 traits, and 2 strategies.
- strategy_oracle_k3_j50_s2: 50 items, 3 traits, and 2 strategies.
- strategy_oracle_k4_j20_s2: 20 items, 4 traits, and 2 strategies.
- strategy_oracle_k4_j30_s2: 30 items, 4 traits, and 2 strategies.
- strategy_oracle_k4_j40_s2: 40 items, 4 traits, and 2 strategies.
- strategy_oracle_k4_j50_s2: 50 items, 4 traits, and 2 strategies.

Details

Each entry in a strategy is denoted by either 1, if the item uses the skill under strategy s , or 0, if the item does not use the skill under strategy s .

Note: Each matrix in the strategy was generated independently under the criterion for a strictly identifiable Q matrix.

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