

Package ‘psketti’

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Type Package

Title Generating Investigatory Plots and Tables for Rasch Analysis

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Description psketti generates investigatory plots and tables to assist in Rasch Analysis by using a number of accessor, table, and plotting functions. Data are extracted from dichotmous (RM) and partial credit (PCM) Rasch models fitted by Conditional Maximum Likelihood (CML) estimation in the eRm package. Empirical Item Characteristic Curves (ICC) are computed by dividing the latent dimension into class intervals in which the frequency of response to a category is counted and presented as a proportion of that class interval. Confidence Intervals for the Empirical ICC are also calculated. Infit and Outfit measures are also extracted for presentation as a simple diagnostic plot. Plots are compiled using ggplot2.

Depends R (>= 4.0.0)

Imports eRm (>= 1.0-1),
dplyr (>= 1.0.1),
ggplot2 (>= 3.3.2),
viridis (>= 0.5.1),
RColorBrewer (>= 1.1.2),
stats (>= 4.0.2)

Suggests tidyverse (>= 1.3.0),
knitr,
rmarkdown

License GPL (>= 3)

Encoding UTF-8

LazyData true

RoxygenNote 7.1.1

VignetteBuilder knitr

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FakeData	<i>Fake Data</i>
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Description

Simulated scored data for 23 items and 1200 participants, where items were presented in random order to each participant. Contains responses for dichotomous (X), and polychotomous (K) data. Item delivery order is stored in the Index column Data were simulated according to suggestions in Linacre (2007). Data are stored in long format.

Usage

```
data(FakeData)
```

Format

An object of class "cross"; see [read.cross](#).

Source

[Rasch Measurement Transactions](#)

References

Linacre. (2013) Rasch Measurement Transactions 21:3 p. 1125 ([Rasch Measurement Transactions](#))

Examples

```
# Show fake data
data(FakeData)

library(tidyverse)
# Count of item responses by item and polychotomous category
count_by_reponse_K <- FakeData %>% group_by(Item, K) %>% summarise(Count = n())
```

*FakeItems**Fake Items*

Description

Item parameters for simulated scored data for 23 items and 1200 participants, where items were presented in random order to each participant. Contains responses for dichotomous (X), and polychotomous (K) data. Item delivery order is stored in the Index column. Data were simulated according to suggestions in Linacre (2007). Data are stored in long format.

Usage

```
data("FakeItems")
```

Format

An object of class "cross"; see [read.cross](#).

Source

[Rasch Measurement Transactions](#)

References

Linacre. (2013) Rasch Measurement Transactions 21:3 p. 1125 ([Rasch Measurement Transactions](#))

Examples

```
# Show fake item parameters
data("FakeItems")
```

*FakePCMDData**Fake Data*

Description

Simulated scored data for 10 items and 1200 participants, where items were presented in random order to each participant. Contains responses for dichotomous (X), and polychotomous (K) data. Item delivery order is stored in the Index column. Data were simulated according to suggestions in Linacre (2007). Data are stored in long format.

Usage

```
data("FakePCMDData")
```

Format

An object of class "cross"; see [read.cross](#).

Source

[Rasch Measurement Transactions](#)

References

Linacre. (2013) Rasch Measurement Transactions 21:3 p. 1125 ([Rasch Measurement Transactions](#))

Examples

```
# Show fake data
data("FakePCMDData")

library(tidyverse)
# Count of item responses by item and polychotomous category
count_item_by_reponse_K <- FakePCMDData %>%
  pivot_longer(cols = -ID,
               names_to = "Item",
               values_to = "Response") %>%
  group_by(Item, Response) %>%
  summarise(Count = n())
```

FakePCMIItems

Fake Items

Description

Item parameters for simulated scored data for 11 items and 1200 participants, where items were presented in random order to each participant. Contains responses for dichotomous (X), and polychotomous (K) data. Item delivery order is stored in the Index column. Data were simulated according to suggestions in Linacre (2007). These are the resulting item parameters.

Usage

```
data("FakePCMIItems")
```

Format

An object of class "cross"; see [read.cross](#).

Source

[Rasch Measurement Transactions](#)

References

Linacre. (2013) Rasch Measurement Transactions 21:3 p. 1125 ([Rasch Measurement Transactions](#))

Examples

```
# Show fake item parameters
data("FakePCMIItems")
```

ingrediente	<i>Score Report Tables</i>
-------------	----------------------------

Description

Generates score report for dataframe.

Usage

```
ingrediente(x, ID, Item, Score, K, K_options, Index = NULL)
```

Arguments

x	a dataframe.
ID	column name for ID column
Item	column name for Item column
Score	a column name for response scores
K	column name for column containing multiple choice responses
K_options	An ordered factor object to arrange column order in the score table.
Index	Column name for order of administration per participant. This can also be an ordered factor for the item names. Orders the Response string. Defaults to 'NULL', using the items to order the response string.

Value

Score reports for participants, with counts of category selection and a score string ordered by score string index

Examples

```
# Example 1
# For dichotomous Rasch model
library(psketti)
data("FakeData")

K_opt <- factor(LETTERS[1:5], levels = LETTERS[1:5], ordered = TRUE)
score_report <- ingrediente(x = FakeData,
                           Item = "Item",
                           ID = "ID",
                           Score = "X",
                           K = "K",
                           K_options = K_opt,
                           Index = "Index")

# show score report for values with a total score <= 5
score_report[score_report$total_score <= 1, ]
# Score report ordering response string by item difficulty
data("FakeItems")
FI2 <- FakeItems[order(FakeItems$Beta),]
row.names(FI2) <- NULL
FI_factor <- factor(FI2$Item, levels = FI2$Item, ordered = TRUE)
```

```

score_report2 <- ingrediente(x = FakeData,
                           Item = "Item",
                           ID = "ID",
                           Score = "X",
                           K = "K",
                           K_options = K_opt,
                           Index = FI_factor)

# show score report for values with a total score <= 5
score_report2[score_report2$total_score == 21, ]

## Not run:
# Example 2
# For Rasch partial credit model
library(dplyr)
library(tidyr)
data("FakePCMDData")
data("FakePCMIItems")

# Arrange Data, wide to long
fpcm <- FakePCMDData %>%
  pivot_longer(cols = -ID, values_to = "Response", names_to = "Item") %>%
  mutate(X = Response) %>%
  mutate(K = as.character(Response)) %>%
  mutate(K = recode(K, "0" = "A", "1" = "B", "2" = "C", "3" = "D"))

# factor variable: Index for item order
F2 <- FakePCMIItems[, c("Item", "Beta")] # extract relevant cols
F2 <- F2[order(F2$Beta),] # order dataframe
row.names(F2) <- NULL # drop rownames

# create factor variable
F_factor <- factor(F2$Item,
                  levels = F2$Item,
                  ordered = TRUE)

# apply factor to data frame
fpcm$Index <- fpcm$Item # Item -> Index
fpcm$Index <- factor(fpcm$Index,
                  levels = levels(F_factor),
                  ordered = TRUE)

fpcm <- as.data.frame(fpcm) # ensure this is a dataframe!!

# factor variable for K categories
K_opt <- factor(LETTERS[1:4],
               levels = LETTERS[1:4],
               ordered = TRUE)

# produce score report
score_pcm <- ingrediente(x = fpcm,
                       Item = "Item",
                       ID = "ID",
                       Score = "X",
                       K = "K",
                       Index = "Index",

```

```

K_options = K_opt)

score_pcm[score_pcm$total_score < 2, ] # print out score report

## End(Not run)

```

item_fit_table	<i>Create Item Fit Table</i>
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Description

This function extracts Item fit statistics from eRm ‘itemfit()’

Usage

```
item_fit_table(eRm.obj)
```

Arguments

eRm.obj input data, generated using a Rasch model estimation function from eRm.

Value

A data.frame of class ItemFit.

Examples

```

library(eRm)
library(psketti)

data("FakeData") # load data
# restructure fake data
Fake_Data_scores <- reshape(FakeData[, c("ID", "Item", "X")],
                             timevar = "Item",
                             idvar = "ID",
                             direction = "wide")
# for eRm col names and row names
names(Fake_Data_scores) <- c("ID",
                             paste0("i",
                                     sprintf(fmt = "%02d", 1:23)))

row.names(Fake_Data_scores) <- Fake_Data_scores$ID
Fake_Data_scores$ID <- NULL

fake_rm <- RM(Fake_Data_scores) # Estimate Rasch model

itemFit_psk <- item_fit_table(fake_rm) # item fit stats

itemFit_psk # output

```

Description

This function extracts data from an eRm object of class 'RM' and converts to a format for plotting data. This also computes the empirical response values and empirical confidence intervals

Usage

```
psketti(
  pskettified_data,
  p.style = "present",
  p.IRFLocation = TRUE,
  p.empCI = TRUE,
  p.empICC = TRUE,
  p.empPoints = TRUE,
  Force_no_facet = FALSE
)
```

Arguments

pskettified_data	a list object generated from eRm object class 'RM' using 'pskettify()'.
p.style	a character string for plotting style options are present for coloured plots, or print for black and white plots. Defaults to "present".
p.IRFLocation	logical, plots reference lines for Rasch IRF location. Defaults to 'TRUE'.
p.empCI	logical, plots confidence intervals for empirical points, calculated using 'pskettify()'. Defaults to 'TRUE'.
p.empICC	logical, plots empirical ICC for item. Defaults to 'TRUE'.
p.empPoints	logical, plots empirical points for based on class intervals/ score groups generated with 'pskettify()'. Defaults to 'TRUE'.
Force_no_facet	a logical, forces psketti to not use facets for polytomous models. Defaults to 'FALSE'.

Value

A list object containing multiple psketto plots.

Examples

```
library(eRm)
library(psketti)

data("FakeData") # load data
# restructure fake data
Fake_Data_scores <- reshape(FakeData[, c("ID", "Item", "X")],
  timevar = "Item",
  idvar = "ID",
  direction = "wide")
```



```

# for eRm col names and row names
names(Fake_Data_scores) <- c("ID",
                             paste0("i",
                                     sprintf(fmt = "%02d", 1:23)))

row.names(Fake_Data_scores) <- Fake_Data_scores$ID
Fake_Data_scores$ID         <- NULL

fake_rm    <- RM(Fake_Data_scores) # Estimate Rasch model

psk_data   <- pskettify(fake_rm)   # pskettify data

# multiple plots
multi_plot <- pskettti(pskettified_data = psk_data)
multi_plot # plot call instructions

# print first item plot
multi_plot$Plot.List[['i01']][[1]]

```

pskettify

pskettify your data

Description

This function extracts data from an eRm object of class 'RM' and converts to a format for plotting data. This also computes the empirical response values and empirical confidence intervals.

Usage

```
pskettify(eRm.obj, conf.level = 0.95, Theta.lwr = -6, Theta.upr = 6)
```

Arguments

eRm.obj	an eRm object of class 'RM'.
conf.level	the confidence level for empirical response curve. Defaults to 0.95.
Theta.lwr	The lowest limit of the latent dimension. Defaults to -6.
Theta.upr	The highest limit of the latent dimension. Defaults to 6.

Value

output_list containing presp and emp_ICC.
presp a data frame of ability (Theta) and conditional response probabilities to each item.
emp_ICC a dataframe containing proportion values and confidence intervals for ability class intervals to each item.

Examples

```

library(eRm)
library(psketti)

data("FakeData") # load data
# restructure fake data

```

```

Fake_Data_scores <- reshape(FakeData[, c("ID", "Item", "X")],
                             timevar = "Item",
                             idvar = "ID",
                             direction = "wide")
# for eRm col names and row names
names(Fake_Data_scores) <- c("ID",
                             paste0("i",
                                     sprintf(fmt = "%02d", 1:23)))

row.names(Fake_Data_scores) <- Fake_Data_scores$ID
Fake_Data_scores$ID <- NULL

fake_rm <- RM(Fake_Data_scores) # Estimate Rasch model

psk_data <- pskettify(fake_rm) # pskettify data

```

psketi_distractor *Distractor Analysis Plots*

Description

Implementation of a graphical (Asril and Marais, 2011) approach to assigning a partial credit scoring system to data previously estimated with a dichotomous Rasch model. The function console output prints object details, a list of items, and generic example of how to call the plot.

Usage

```

psketi_distractor(
  x,
  ID,
  Item,
  K,
  response_options,
  eRm.obj,
  p.style = "present",
  distractor_colours = NULL
)

```

Arguments

x	A long formatted dataframe
ID	column name for ID column
Item	column name for Item column
K	column name for column containing multiple choice responses.
response_options	An ordered factor object to arrange column order in the distractor table.
eRm.obj	An object of class eRm and model RM. Use 'eRm::RM(score_data)' to create this object. To plot empirical values for PCM see 'pskettify', 'psketi' and 'psketto'.
p.style	Plot output style, "print" for black and white, or "present" for color. Defaults to "present".

distractor_colours

An optional vector of colours for distractor plot lines. Must be the same length as response_options. Defaults to 'NULL' for viridis color palette.

Value

Plot.List is a list object containing plots of empirical distractor proportions plotted against the dichotomous Rasch IRF.

Examples

```
library(eRm)
library(psketti)
data("FakeData")
Fake_Data_scores <- reshape(FakeData[, c("ID", "Item", "X")],
                             timevar = "Item",
                             idvar = "ID",
                             direction = "wide")

# set column names to be equal to original item names
names(Fake_Data_scores) <- c("ID",
                             paste0("i",
                                     sprintf(fmt = "%02d", 1:23)))

row.names(Fake_Data_scores) <- Fake_Data_scores$ID # set ID as row names
Fake_Data_scores$ID <- NULL # drop the ID column
fake_rm <- RM(Fake_Data_scores) # fit a Rasch Model

# Prepare response options factor
r_o <- factor(sort(unique(FakeData$K)), # input var
              levels = sort(unique(FakeData$K)), # factor levels
              ordered = TRUE) # ordered

# multiple plots
spag_plot <- psketti_distractor(ID = "ID", # set ID column
                               Item = "Item", # set Item column
                               K= "K", # Set resp categories
                               x = FakeData, # select data
                               eRm.obj = fake_rm, # select eRm object
                               response_options = r_o, # set resp options
                               p.style = "present") # set plotting style

spag_plot # plot call instructions
spag_plot$Plot.List[['i01']][[1]] # plot item 1
```

psketto

Plot a Single ICC

Description

psketto is singular of psketti; (spaghetti <-> spaghetti). This function plots the data for a single item from the output of 'pskettify()'. 'psketto()' is also used in 'psketti()' to create multiple ICC plots. Based on Asril and Marais (2011).

Usage

```
psketto(
  pskettified_data,
  item,
  item.label,
  style = "present",
  IRFLocation = TRUE,
  empCI = TRUE,
  empICC = TRUE,
  empPoints = TRUE,
  facet_curves = FALSE
)
```

Arguments

pskettified_data	input data, generated using 'pskettify()'.
item	character name of the item to be plotted
item.label	a character string of the item name to use.
style	a character string for plotting style options are present for coloured, or print for black and white. Defaults to "present".
IRFLocation	logical, plots reference lines for Rasch IRF location. Defaults to 'TRUE'
empCI	logical, plots confidence intervals for empirical points, calculated using 'pskettify()'. Defaults to 'TRUE'
empICC	logical, plots empirical ICC for item. Defaults to 'TRUE'
empPoints	logical, plots empirical points for based on class intervals/score groups generated with 'pskettify()'. Defaults to 'TRUE'
facet_curves	logical, should the plot be faceted by category curve? Applies only to polytomous Rasch models. Defaults to 'FALSE',.

Value

psketto plot.

Examples

```
library(eRm)
library(psketti)

data("FakeData") # load data
# restructure fake data
Fake_Data_scores <- reshape(FakeData[, c("ID", "Item", "X")],
  timevar = "Item",
  idvar = "ID",
  direction = "wide")

# for eRm col names and row names
names(Fake_Data_scores) <- c("ID",
  paste0("i",
    sprintf(fmt = "%02d", 1:23)))

row.names(Fake_Data_scores) <- Fake_Data_scores$ID
Fake_Data_scores$ID <- NULL
```

```

fake_rm    <- RM(Fake_Data_scores) # Estimate Rasch model

psk_data   <- pskettify(fake_rm)    # pskettify data

# plot IRF in default colours
psk_1_present <- psketto(psk_data,
                        style = "present",
                        item = "i01",
                        item.label = "i01")
psk_1_present # plot output

# plot IRF in default greyscale colours
psk_1_print <- psketto(psk_data,
                      style = "print",
                      item = "i01",
                      item.label = "i01")
psk_1_print # plot output

```

pskett_msq

Plot a Infit and Outfit MSQ

Description

This function plots the Infit and Outfit MSQ values from a item of class ItemFit. see ‘item_fit_table()’. Based on Yu (2020).

Usage

```
psketti_msq(x, style = "present")
```

Arguments

x	input data, generated using ‘item_fit_table()’.
style	a character string for plotting style options are present for coloured, or print for black and white. Defaults to "present".

Value

MSQ plot.

Examples

```

library(eRm)
library(psketti)

data("FakeData") # load data
# restructure fake data
Fake_Data_scores <- reshape(FakeData[, c("ID", "Item", "X")],
                           timevar = "Item",
                           idvar = "ID",
                           direction = "wide")

# for eRm col names and row names
names(Fake_Data_scores) <- c("ID",

```

```

      paste0("i",
             sprintf(fmt = "%02d", 1:23)))

row.names(Fake_Data_scores) <- Fake_Data_scores$ID
Fake_Data_scores$ID         <- NULL

fake_rm      <- RM(Fake_Data_scores)      # Estimate Rasch model

itemFit_psk <- item_fit_table(fake_rm) # item fit stats
MSQplot     <- psketti_msq(itemFit_psk) # Plot infit and outfit

MSQplot

```

tabliatelle	<i>Distractor Analysis Tables</i>
-------------	-----------------------------------

Description

Implementation of the tabular (Andrich and Styles, 2009) approach to assigning a partial credit scoring system to data previously modeled with a dichotomous Rasch model.

Usage

```
tabliatelle(x, ID, Item, K, response_options, eRm.obj)
```

Arguments

x	A long formatted dataframe.
ID	column name for ID column.
Item	column name for Item column.
K	column name for column containing multiple choice responses.
response_options	An ordered factor object to arrange column order in the distractor table.
eRm.obj	An object of class eRm and model RM. Use 'eRm::RM(score_data)' to create this object.

Value

tabliatelle returns a list of class tabliatelle.

Examples

```

library(eRm)
library(psketti)

data("FakeData") # load data
# restructure fake data
Fake_Data_scores <- reshape(FakeData[, c("ID", "Item", "X")],
                             timevar = "Item",
                             idvar = "ID",
                             direction = "wide")

# for eRm col names and row names

```

```
names(Fake_Data_scores) <- c("ID",
                             paste0("i",
                                     sprintf(fmt = "%02d", 1:23)))

row.names(Fake_Data_scores) <- Fake_Data_scores$ID
Fake_Data_scores$ID         <- NULL

fake_rm  <- RM(Fake_Data_scores) # Estimate Rasch model

# Prepare response options factor
r_o <- factor(sort(unique(FakeData$K)),          # input var
              levels = sort(unique(FakeData$K)), # factor levels
              ordered = TRUE)                   # ordered
# tabliatellify
tlt_data <- tabliatelle(x = FakeData,
                       eRm.obj = fake_rm,
                       ID = "ID",
                       Item = "Item",
                       K = "K",
                       response_options = r_o)

tlt_data # output
```

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