

Package ‘SSRA’

January 20, 2025

Type Package

Title Sakai Sequential Relation Analysis

Version 0.1-1

Date 2024-10-17

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Description 'Takea Semantic Structure Analysis' (TSSA) and 'Sakai Sequential Relation Analysis' (SSRA) for polytomous items. Package includes functions for generating a sequential relation table and a treegram to visualize the sequential relations between pairs of items.

License GPL-3

LazyLoad yes

LazyData true

Imports shape, stringr

Depends R (>= 3.2.0)

RoxygenNote 5.0.1

NeedsCompilation no

Repository CRAN

Date/Publication 2024-10-17 10:00:02 UTC

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exdat	<i>Example data based on Takeya (1991)</i>
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Description

A dataset containing 10 observations on 5 items.

Usage

```
exdat
```

Format

A data frame with 10 rows and 5 variables

plot.ssra	<i>Plot ssra</i>
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Description

Function for plotting the ssra object

Usage

```
## S3 method for class 'ssra'
plot(x, r.crt = NULL, r.sig = TRUE, d.sq = NULL,
     m.sig = TRUE, sig.col = TRUE, col = c("red2", "green4", "blue3",
     "black"), pch = c(1, 2, 0, 4), mar = c(3.5, 3.5, 1.5, 1), ...)
```

Arguments

x	requires the return object from the SSRA function
r.crt	minimal absolute correlation to be judged 'sequential'
r.sig	plot statistically significant correlations
d.sq	minimal effect size Cohen's d to be judged 'sequential'
m.sig	plot statistically significant mean difference
sig.col	significance in different colors
col	color code or name
pch	plotting character
mar	number of lines of margin to be specified on the four sides of the plot
...	further arguments passed to or from other methods

Details

Takeya Semantic Structure Analysis (TSSA) and Sakai Sequential Relation Analysis (SSRA) are graphical approaches

Author(s)

Takuya Yanagida Keiko Sakai

References

Takeya, M. (1991). *A new test theory: Structural analyses for educational information*. Tokyo: Waseda University Press.

See Also

[SSRA](#), [treegram](#), [scatterplot](#)

Examples

```
## Not run:  
# Example data based on Takeya (1991)  
  
# Sakai Sequential Relation Analysis  
# ordering assessed according to the correlation coefficient and mean difference  
exdat.ssra <- SSRA(exdat, output = FALSE)  
plot(exdat.ssra)  
  
## End(Not run)
```

print.ssra

Sakai Sequential Relation Analysis Print

Description

print function for the ssra object

Usage

```
## S3 method for class 'ssra'  
print(x, digits = 3, ...)
```

Arguments

x	requires the result object of hssr function
digits	integer indicating the number of decimal places to be used
...	further arguments passed to or from other methods

Details

Takea Semantic Structure Analysis (TSSA) and Sakai Sequential Relation Analysis (SSRA) are graphical approaches

Author(s)

Takuya Yanagida Keiko Sakai

References

Takeya, M. (1991). *A new test theory: Structural analyses for educational information*. Tokyo: Waseda University Press.

See Also

[seqtable](#)

Examples

```
# Example data based on Takeya (1991)

# Sakai Sequential Relation Analysis
# ordering assessed according to the correlation coefficient and mean difference
exdat.ssra <- SSRA(exdat, output = FALSE)
print(exdat.ssra)
```

print.tssa

Semantric Structure Analysis Print

Description

print function for the tssa object

Usage

```
## S3 method for class 'tssa'
print(x, digits = 3, ...)
```

Arguments

x	requires the result object of hssr function
digits	integer indicating the number of decimal places to be used
...	further arguments passed to or from other methods

Details

Takea Semantic Structure Analysis (TSSA) and Sakai Sequential Relation Analysis (SSRA) are graphical approaches

Author(s)

Takuya Yanagida Keiko Sakai

References

Takeya, M. (1991). *A new test theory: Structural analyses for educational information*. Tokyo: Waseda University Press.

See Also

[seqtable](#)

Examples

```
# Example data based on Takeya (1991)

# Takea Semantic Structure Analysis
# ordering assessed according to the ordering coefficient
exdat.tssa <- TSSA(exdat, m = 5, output = FALSE)
print(exdat.tssa)

# Takea Semantic Structure Analysis including statistical testing
# ordering assessed according to the ordering coefficient and statistical significance
exdat.tssa <- TSSA(exdat, m = 5, sig = TRUE, output = FALSE)
print(exdat.tssa)
```

scatterplot

Scatterplot Matrices

Description

This function produces a scatterplot matrix

Usage

```
scatterplot(data, type = c("jitter", "size", "count", "sun"))
```

Arguments

data	a data frame
type	type of plot, i.e., 'jitter', 'size', 'count', and 'sun'

Details

Takea Semantic Structure Analysis (TSSA) and Sakai Sequential Relation Analysis (SSRA) are graphical approaches

Author(s)

Takuya Yanagida Keiko Sakai

References

Takeya, M. (1991). *A new test theory: Structural analyses for educational information*. Tokyo: Waseda University Press.

See Also

[TSSA](#), [SSRA](#)

Examples

```
# Example data based on Takeya (1991)

# Scatterplot matrix: jitter
scatterplot(exdat)

# Scatterplot matrix: size
scatterplot(exdat, type = "size")

# Scatterplot matrix: count
scatterplot(exdat, type = "count")

# Scatterplot matrix: sun
scatterplot(exdat, type = "sun")
```

seqtable

Sequential Relation Table

Description

This function builds a table for the tssa and ssra object used to create a treegram

Usage

```
seqtable(object, order = c("no", "decreasing", "increasing"), digits = 3,
         output = TRUE)
```

Arguments

object	requires the return object from the TSSA or SSRA function
order	sort by item mean of j?
digits	integer indicating the number of decimal places to be used
output	print result table?

Details

Takea Semantic Structure Analysis (TSSA) and Sakai Sequential Relation Analysis (SSRA) are graphical approaches

Author(s)

Takuya Yanagida Keiko Sakai

References

Takeya, M. (1991). *A new test theory: Structural analyses for educational information*. Tokyo: Waseda University Press.

See Also

[TSSA](#), [SSRA](#), [treegram](#), [summary.seqtable](#)

Examples

```
# Example data based on Takeya (1991)

# Takea Semantic Structure Analysis
# ordering assessed according to the correlation coefficient and mean difference
exdat.tssa <- TSSA(exdat, m = 5, output = FALSE)
seqtable(exdat.tssa)

# Sakai Sequential Relation Analysis
# ordering assessed according to the correlation coefficient and mean difference
exdat.ssra <- SSRA(exdat, output = FALSE)
seqtable(exdat.ssra)
```

SSRA

Sakai Sequential Relation Analysis

Description

This function conducts the Sequential Relation Analysis based on Sakai 2016

Usage

```
SSRA(dat, r.crt = 0.3, mu.sq = 0, mu.eq = Inf, d.sq = 0.2, d.eq = 0.2,
      pairwise = TRUE, method = c("pearson", "kendall", "spearman"),
      alpha = 0.05, p.adjust.method = c("holm", "hochberg", "hommel",
      "bonferroni", "BH", "BY", "fdr", "none"), digits = 3, vnames = TRUE,
      order = c("no", "decreasing", "increasing"), exclude = TRUE,
      output = TRUE)
```

Arguments

<code>dat</code>	requires a data frame with polytomous data
<code>r.crt</code>	correlation coefficient criterion to be judged 'sequential' or 'equivalent'
<code>mu.sq</code>	Absolute mean difference criterion to be judged 'sequential'
<code>mu.eq</code>	maximal absolute mean difference to be judged 'equivalent'
<code>d.sq</code>	effect size for mean difference criterion to be judged 'sequential'
<code>d.eq</code>	maximal effect size Cohen's d to be judged 'equivalent'
<code>pairwise</code>	pairwise deletion of missing data, if <code>pairwise = FALSE</code> listwise deletion is applied
<code>method</code>	character string indicating which correlation coefficient to be used, 'pearson' = Pearson's product moment correlation coefficient 'spearman' = Spearman's rho statistic 'kendall' = Kendall's tau (default)
<code>alpha</code>	significance level
<code>p.adjust.method</code>	p-value correction method for multiple comparisons, see: <code>?p.adjust</code> (default = <code>holm</code>)
<code>digits</code>	integer indicating the number of decimal places to be used
<code>vnames</code>	use variable names for labeling?
<code>order</code>	sort by item mean of j and k?
<code>exclude</code>	exclude paths with no relationship?
<code>output</code>	print result table?

Details

Takea Semantic Structure Analysis (TSSA) and Sakai Sequential Relation Analysis (SSRA) are graphical approaches

Value

Returns an object of class `ssra`, to be used for the `seqtable` function. The object is a list with following entries: 'dat' (data frame), 'call' (function call), 'args' (specification of arguments), 'time' (time of analysis), 'R' (R version), 'package' (package version), and 'restab' (result table). The 'restab' entry has following entries:

<code>j</code>	item j
<code>k</code>	item k
<code>n</code>	sample size
<code>j.mean</code>	mean of item j
<code>j.sd</code>	standard deviation of item j
<code>k.mean</code>	mean of item k
<code>k.sd</code>	standard deviation of item k
<code>r</code>	correlation coefficient
<code>r.t</code>	test statistic of the statistical significanc test for the correlation coefficient
<code>r.p</code>	statistical significance value of the correlation

r.sig	statistical significance of the correlation (0 = not significant / 1 = significant)
r.crt	correlation criterion for judging 'sequential' or 'equal': 'r.p < alpha' and 'r > r.crt' (0 = no / 1 = yes)
m.diff	mean difference
sd.diff	standard deviation difference
m.diff.eff	effect size Cohen's d for dependent samples
m.t	test statistic of the statistical significanc test for mean difference
m.p	statistical significance value of the mean difference
m.sig	statistical significance of the mean difference (0 = not significant / 1 = significant)
m.crt.sq	mean difference criteria for judging 'sequential': 'm.diff.p < alpha', 'm.diff > mu.sq' and 'm.diff.eff > d.sq' (0 = no / 1 = yes)
m.crt.eq	mean difference criteria for judging 'equivalence': statistical significant and 'm <= mu.eq' 'd <= d.sq' (0 = no / 1 = yes)
seq	sequential relation of item pairs ("+", "-", "")
eq	equivalence of item pairs ("=" or "")
order	order structure of item pairs ("=", "+", "-")

Author(s)

Takuya Yanagida Keiko Sakai

References

Takeya, M. (1991). *A new test theory: Structural analyses for educational information*. Tokyo: Waseda University Press.

See Also

[seqtable](#), [TSSA](#), [plot.ssra](#), [scatterplot](#)

Examples

```
# Example data based on Takeya (1991)

# Sakai Sequential Relation Analysis
# ordering assesed according to the correlation coefficient and mean difference
SSRA(exdat)
```

summary.seqtable *Sequential Relationship Table Summary*

Description

summary function for the seqtab object

Usage

```
## S3 method for class 'seqtable'
summary(object, exclude = TRUE, ...)
```

Arguments

object	requires the result object of seqtable function
exclude	exclude lower-order paths (i.e., paths included in higher order paths)?
...	additional arguments affecting the summary produced

Details

Takeya Semantic Structure Analysis (TSSA) and Sakai Sequential Relation Analysis (SSRA) are graphical approaches

Value

rel	relationship: sq = sequential / eq = equal
var	variables involved in the sequential/equal paths

Author(s)

Takuya Yanagida Keiko Sakai

References

Takeya, M. (1991). *A new test theory: Structural analyses for educational information*. Tokyo: Waseda University Press.

See Also

[SSRA, TSSA](#)

Examples

```
# Example data based on Takeya (1991)

# Sakai Sequential Relation Analysis
# ordering assessed according to the correlation coefficient and mean difference
exdat.ssra <- SSRA(exdat, output = FALSE)
exdat.seqtab<- seqtable(exdat.ssra, output = FALSE)
summary(exdat.seqtab)
```

treegram	<i>Treegram</i>
----------	-----------------

Description

This function draws a treegram for the Takea Semantic Structure Analysis (TSSA) and Sakai Sequential Relation Analysis (SSRA)

Usage

```
treegram(object, select = NULL, pos = NULL, col = NULL, mai = c(0.2, 0,
  0.2, 0.2), print.pos = TRUE, cex.text = 0.95, x.factor = 1.7,
  x.digits = 0, y.digits = 2, y.intersp = 1.45, cex.legend = 0.9)
```

Arguments

object	requires the result object of seqtab function
select	select items to be plotted
pos	position of items on the x-axis
col	color code or name for paths
mai	numeric vector of the form c(bottom, left, top, right) which gives the margin size specified in inches
print.pos	display x/y-position as legend
cex.text	text expansion factor relative to current par("cex")
x.factor	shift factor of legend position
x.digits	decimal places of x-position
y.digits	decimal places of y-position
y.intersp	legend character interspacing factor for vertical (y) line distances
cex.legend	legend character expansion factor relative to current par("cex")

Details

Takea Semantic Structure Analysis (TSSA) and Sakai Sequential Relation Analysis (SSRA) are graphical approaches

Author(s)

Takuya Yanagida Keiko Sakai

References

Takeya, M. (1991). *A new test theory: Structural analyses for educational information*. Tokyo: Waseda University Press.

See Also[seqtable](#)**Examples**

```
# Example data based on Takeya (1991)

# Sakai Sequential Relation Analysis
# ordering assessed according to the correlation coefficient and mean difference
exdat.ssra <- SSRA(exdat, output = FALSE)
exdat.seqtab <- seqtable(exdat.ssra, output = FALSE)
treegram(exdat.seqtab)

# Select items to be plotted
exdat.ssra <- SSRA(exdat, output = FALSE)
exdat.seqtab <- seqtable(exdat.ssra, output = FALSE)
treegram(exdat.seqtab, select = c("Item2", "Item3", "Item4"))

# Define position for each item on the x-axis
exdat.ssra <- SSRA(exdat, output = FALSE)
exdat.seqtab <- seqtable(exdat.ssra, output = FALSE)
treegram(exdat.seqtab, pos = c(Item5 = 1, Item4 = 3,
                               Item3 = 5, Item2 = 2, Item1 = 4))

# Change colors for each path of an item
exdat.ssra <- SSRA(exdat, output = FALSE)
exdat.seqtab <- seqtable(exdat.ssra, output = FALSE)
treegram(exdat.seqtab,
         col = c(Item5 = "red3", Item4 = "blue3",
                 Item3 = "gray99", Item2 = "darkgreen", Item1 = "darkorange2"))
```

TSSA

Takeya Semantic Structure Analysis

Description

This function conducts the Semantic Structure Analysis for polytomous items based on Takeya 1991

Usage

```
TSSA(dat, m, crit = 0.93, pairwise = TRUE, sig = FALSE, exact = TRUE,
     alpha = 0.05, p.adjust.method = c("holm", "hochberg", "hommel",
     "bonferroni", "BH", "BY", "fdr", "none"), digits = 3, vnames = TRUE,
     order = c("no", "decreasing", "increasing"), exclude = TRUE,
     output = TRUE)
```

Arguments

<code>dat</code>	requires a data frame with polytomous data, all items need to have the same numbers of response categories
<code>m</code>	requires the number of item response categories
<code>crit</code>	criteria for ordering coefficient
<code>pairwise</code>	pairwise deletion of missing data, if <code>pairwise = FALSE</code> listwise deletion if applied
<code>sig</code>	if <code>sig = TRUE</code> , ordering will be assessed according to ordering coefficient and statistical significance
<code>exact</code>	if <code>exact = TRUE</code> , exact binomial test will be applied otherwise single-sample proportion test will be applied
<code>alpha</code>	significance level
<code>p.adjust.method</code>	p-value correction method for multiple comparisons, see: <code>?p.adjust</code> (default = <code>holm</code>)
<code>digits</code>	integer indicating the number of decimal places to be used
<code>vnames</code>	use variable names for labeling?
<code>order</code>	sort by item mean of j and k?
<code>exclude</code>	exclude paths with no relationship?
<code>output</code>	print result table?

Details

Takea Semantic Structure Analysis (TSSA) and Sakai Sequential Relation Analysis (SSRA) are graphical approaches

Value

Returns an object of class `tssa`, to be used for the `seqtable` function. The object is a list with following entries: `'dat'` (data frame), `'call'` (function call), `'args'` (specification of arguments), `'time'` (time of analysis), `'R'` (R version), `'package'` (package version), and `'restab'` (result table). The `'restab'` entry has following entries:

<code>j</code>	item j
<code>k</code>	item k
<code>n</code>	sample size
<code>j.mean</code>	mean of item j
<code>j.sd</code>	standard deviation of item j
<code>k.mean</code>	mean of item k
<code>k.sd</code>	standard deviation of item k
<code>c.jk</code>	ordering coefficient j -> k
<code>p.jk</code>	p-value j -> k (available if <code>sig = TRUE</code>)
<code>sig.jk</code>	statistical significance p-value j -> k (0 = no / 1 = yes; available if <code>sig = TRUE</code>)
<code>c.kj</code>	ordering coefficient k -> j

p.kj p-value k -> j (0 = no / 1 = yes; available if sig = TRUE)
sig.kj statistical significance p-value k -> j (available if sig = TRUE)
crt.jk ordering j -> k
crt.kj ordering k -> j
order order structure of item pairs ("=", "+", "-")

Author(s)

Takuya Yanagida Keiko Sakai

References

Takeya, M. (1991). *A new test theory: Structural analyses for educational information*. Tokyo: Waseda University Press.

See Also

[SSRA](#), [seqtable](#), [scatterplot](#)

Examples

```
# Example data based on Takeya (1991)

# Takea Semantic Structure Analysis
# ordering assessed according to the ordering coefficient
TSSA(exdat, m = 5)

# Takea Semantic Structure Analysis including statistical testing
# ordering assessed according to the ordering coefficient and statistical significance
TSSA(exdat, m = 5, sig = TRUE)
```

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