Package 'SSRA'

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Title Sakai Sequential Relation Analysis

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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

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Contents

`exdat` *Example data based on Takeya (1991)*

Description

A dataset containing 10 observations on 5 items.

Usage

```
exdat
```

Format

A data frame with 10 rows and 5 variables

`plot.ssra` *Plot ssra*

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

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

SSRA, treegram, scatterplot

Examples

```
## Not run:
# Example data based on Takeya (1991)

# Sakai Sequential Relation Analysis
# ordering assesed 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

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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 assesed 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 assesed according to the ordering coefficient
exdat.tssa <- TSSA(exdat, m = 5, output = FALSE)
print(exdat.tssa)

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

# Sakai Sequential Relation Analysis
# ordering assesed 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

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

j	item j
k	item k
n	sample size
j.mean	mean of item j
j.sd	standard deviation of item j
k.mean	mean of item k
k.sd	standard deviation of item k
r	correlation coefficient
r.t	test statistic of the statistical significanc test for the correlation coefficient
r.p	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
m.crt.eq	mean difference criteria for judging 'equivalence': statistical significant and 'm <= mu.eq' 'd <= d.sq' (0 = no
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

Takea 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 assesed 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` *Treegram*

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 assesed 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 *Takea 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

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

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

p.kj	p-value k -> j (0 = no / 1 = yes; available if sig = TRUE)
sig.kj	statistical significane 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 assesed according to the ordering coefficient
TSSA(exdat, m = 5)

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

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