Package 'longMI'

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Title Longitudinal Measurement Invariance

Version 1.0.0

Description Fits longitudinal measurement invariance models using the 'lavaan' package.
For a thorough exposition of testing measurement invariance,
see Millsap (2011) <doi:10.4324/9780203821961>.

URL https://github.com/ijapesigan/longMI,
https://ijapesigan.github.io/longMI/

BugReports https://github.com/ijapesigan/longMI/issues

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Imports lavaan

Suggests knitr, rmarkdown, testthat

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R topics documented:

`anova.longmi` *Model Comparison Method for an Object of Class* `longmi`

Description

Model Comparison Method for an Object of Class `longmi`

Usage

```
## S3 method for class 'longmi'
anova(object, ...)
```

Arguments

`object`	Object of class `longmi` that is, the output of the `Invariance()` or the `Comparison()` functions.
`...`	Additional arguments to pass to `lavaan::lavTestLRT()`.

Value

Returns a data frame of chi-square difference test results.

Author(s)

Ivan Jacob Agaloos Pesigan

Examples

```
data("osbornesudick1972", package = "longMI")
mi <- Invariance(
  data = osbornesudick1972,
  time_points = c(1, 6),
  factor_loadings = list(
    c(1, 2, 3, 4)
  )
)
anova(mi)
```

`Comparison` *Compare Measurement Invariance Models*

Description

Compare Measurement Invariance Models

Usage

```
Comparison(configural = NULL, weak = NULL, strong = NULL, strict = NULL, ...)
```

Arguments

`configural`	Fitted configural invariance model.
`weak`	Fitted weak invariance model.
`strong`	Fitted strong invariance model.
`strict`	Fitted strict invariance model.
`...`	Additional arguments to pass to `lavaan::lavTestLRT()`.

Value

Returns an object of class `longmi` which is a list with the following elements:

call Function call.

args List of function arguments.

fit Fitted models.

fun Function used ("Comparison").

Author(s)

Ivan Jacob Agaloos Pesigan

See Also

Other Longitudinal Measurement Invariance Functions: `Configural()`, `Invariance()`, `Strict()`, `Strong()`, `Weak()`

Examples

```
data("osbornesudick1972", package = "longMI")
configural_fit <- Configural(
  data = osbornesudick1972,
  time_points = c(1, 6),
  factor_loadings = list(
    c(1, 2, 3, 4)
  )
)
```

```
weak_fit <- Weak(
  data = osbornesudick1972,
  time_points = c(1, 6),
  factor_loadings = list(
    c(1, 2, 3, 4)
  )
)
strong_fit <- Strong(
  data = osbornesudick1972,
  time_points = c(1, 6),
  factor_loadings = list(
    c(1, 2, 3, 4)
  )
)
strict_fit <- Strict(
  data = osbornesudick1972,
  time_points = c(1, 6),
  factor_loadings = list(
    c(1, 2, 3, 4)
  )
)
mi <- Comparison(
  configural = configural_fit,
  weak = weak_fit,
  strong = strong_fit,
  strict = strict_fit
)
print(mi)
summary(mi)
```

`Configural` *Configural Invariance Model*

Description

Configural Invariance Model

Usage

```
Configural(
  data,
  time_points,
  factor_loadings,
  covariances = FALSE,
  model_add = NULL,
  ...
)
```

Arguments

`data`	Dataframe. The function assumes that the data is in the wide format and the variables are named as follows: `paste0("y", time_point, "_", item_number)`. For example, for the item 1 from the first time point, the variable name should be `y1_1`.
`time_points`	Numeric vector of discrete time points.
`factor_loadings`	List with length equal to the number of factors. Each element of the list is the item number of items for the specific factor.
`covariances`	Logical. If `covariance = TRUE`, model the covariances of the measurement error.
`model_add`	Additional specification added to the lavaan model syntax.
`...`	Additional arguments to pass to `lavaan::cfa()`.

Value

Returns a fitted `lavaan` object.

Author(s)

Ivan Jacob Agaloos Pesigan

See Also

Other Longitudinal Measurement Invariance Functions: `Comparison()`, `Invariance()`, `Strict()`, `Strong()`, `Weak()`

Examples

```
data("osbornesudick1972", package = "longMI")
configural_fit <- Configural(
  data = osbornesudick1972,
  time_points = c(1, 6),
  factor_loadings = list(
    c(1, 2, 3, 4)
  )
)
library(lavaan)
summary(configural_fit)
```

`Invariance` *Test Longitudinal Measurement Invariance*

Description

Test Longitudinal Measurement Invariance

Usage

```
Invariance(
  data,
  time_points,
  factor_loadings,
  covariances = FALSE,
  model_add_configural = NULL,
  model_add_weak = NULL,
  model_add_strong = NULL,
  model_add_strict = NULL,
  ...
)
```

Arguments

`data`	Dataframe. The function assumes that the data is in the wide format and the variables are named as follows: `paste0("y", time_point, "_", item_number)`. For example, for the item 1 from the first time point, the variable name should be `y1_1`.
`time_points`	Numeric vector of discrete time points.
`factor_loadings`	List with length equal to the number of factors. Each element of the list is the item number of items for the specific factor.
`covariances`	Logical. If `covariance = TRUE`, model the covariances of the measurement error.
`model_add_configural`	Additional specification added to the lavaan model syntax for the configural invariance model.
`model_add_weak`	Additional specification added to the lavaan model syntax for the weak invariance model.
`model_add_strong`	Additional specification added to the lavaan model syntax for the strong invariance model.
`model_add_strict`	Additional specification added to the lavaan model syntax for the strict invariance model.
`...`	Additional arguments to pass to `lavaan::cfa()`.

Value

Returns an object of class `longmi` which is a list with the following elements:

call Function call.

args List of function arguments.

fit Fitted models.

fun Function used ("Invariance").

Author(s)

Ivan Jacob Agaloos Pesigan

See Also

Other Longitudinal Measurement Invariance Functions: `Comparison()`, `Configural()`, `Strict()`, `Strong()`, `Weak()`

Examples

```
data("osbornesudick1972", package = "longMI")
mi <- Invariance(
  data = osbornesudick1972,
  time_points = c(1, 6),
  factor_loadings = list(
    c(1, 2, 3, 4)
  )
)
print(mi)
summary(mi)
```

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osbornesudick1972 *Wechsler Intelligence Scale for Children Data from Osborne and Sudick (1972)*

Description

Wechsler Intelligence Scale for Children Data from Osborne and Sudick (1972)

Usage

```
osbornesudick1972
```

Format

The data set has the following variables:

id ID

y1_1 Time 1 Information

y1_2 Time 1 Comprehension

y1_3 Time 1 Similarities

y1_4 Time 1 Vocabulary

y6_1 Time 6 Information

y6_2 Time 6 Comprehension

y6_3 Time 6 Similarities

y6_4 Time 6 Vocabulary

References

Osborne, R. T., & Suddick, D. E. (1972). A longitudinal investigation of the intellectual differentiation hypothesis. *The Journal of Genetic Psychology: Research and Theory on Human Development*, *121*(1), 83–89. doi:10.1080/00221325.1972.10533131.

`print.longmi` *Print Method for an Object of Class* `longmi`

Description

Print Method for an Object of Class `longmi`

Usage

```
## S3 method for class 'longmi'
print(
  x,
 measures = c("chisq", "df", "pvalue", "cfi", "tli", "rmsea", "srmr", "aic", "bic"),
  digits = 4,
  ...
)
```

Arguments

`x`	Object of class `longmi` that is, the output of the `Invariance()` or the `Comparison()` functions.
`measures`	Vector of fit measures.
`digits`	Digits to print.
`...`	additional arguments.

Value

Returns a matrix of selected fit measures.

Author(s)

Ivan Jacob Agaloos Pesigan

Examples

```
data("osbornesudick1972", package = "longMI")
mi <- Invariance(
  data = osbornesudick1972,
  time_points = c(1, 6),
  factor_loadings = list(
    c(1, 2, 3, 4)
  )
)
print(mi)
```

Strict *Strict Invariance Model*

Description

Strict Invariance Model

Usage

```
Strict(
  data,
  time_points,
  factor_loadings,
  covariances = FALSE,
  model_add = NULL,
  ...
)
```

Arguments

`data`	Dataframe. The function assumes that the data is in the wide format and the variables are named as follows: `paste0("y", time_point, "_", item_number)`. For example, for the item 1 from the first time point, the variable name should be `y1_1`.
`time_points`	Numeric vector of discrete time points.
`factor_loadings`	List with length equal to the number of factors. Each element of the list is the item number of items for the specific factor.

covariances	Logical. If covariance = TRUE, model the covariances of the measurement error.
model_add	Additional specification added to the lavaan model syntax.
...	Additional arguments to pass to lavaan::cfa().

Value

Returns a fitted lavaan object.

Author(s)

Ivan Jacob Agaloos Pesigan

See Also

Other Longitudinal Measurement Invariance Functions: Comparison(), Configural(), Invariance(), Strong(), Weak()

Examples

```
data("osbornesudick1972", package = "longMI")
strict_fit <- Strict(
  data = osbornesudick1972,
  time_points = c(1, 6),
  factor_loadings = list(
    c(1, 2, 3, 4)
  )
)
library(lavaan)
summary(strict_fit)
```

Strong *Strong Invariance Model*

Description

Strong Invariance Model

Usage

```
Strong(
  data,
  time_points,
  factor_loadings,
  covariances = FALSE,
  model_add = NULL,
  ...
)
```

Arguments

`data`	Dataframe. The function assumes that the data is in the wide format and the variables are named as follows: `paste0("y", time_point, "_", item_number)`. For example, for the item 1 from the first time point, the variable name should be `y1_1`.
`time_points`	Numeric vector of discrete time points.
`factor_loadings`	List with length equal to the number of factors. Each element of the list is the item number of items for the specific factor.
`covariances`	Logical. If `covariance = TRUE`, model the covariances of the measurement error.
`model_add`	Additional specification added to the lavaan model syntax.
`...`	Additional arguments to pass to `lavaan::cfa()`.

Value

Returns a fitted `lavaan` object.

Author(s)

Ivan Jacob Agaloos Pesigan

See Also

Other Longitudinal Measurement Invariance Functions: `Comparison()`, `Configural()`, `Invariance()`, `Strict()`, `Weak()`

Examples

```
data("osbornesudick1972", package = "longMI")
strong_fit <- Strong(
  data = osbornesudick1972,
  time_points = c(1, 6),
  factor_loadings = list(
    c(1, 2, 3, 4)
  )
)
library(lavaan)
summary(strong_fit)
```

summary.longmi *Summary Method for an Object of Class* longmi

Description

Summary Method for an Object of Class longmi

Usage

```
## S3 method for class 'longmi'
summary(
  object,
 measures = c("chisq", "df", "pvalue", "cfi", "tli", "rmsea", "srmr", "aic", "bic"),
  ...
)
```

Arguments

object	Object of class longmi that is, the output of the Invariance() or the Comparison() functions.
measures	Vector of fit measures.
...	additional arguments to pass to the summary function in lavaan

Value

Returns a list of the summary of the fitted models.

Author(s)

Ivan Jacob Agaloos Pesigan

Examples

```
data("osbornesudick1972", package = "longMI")
mi <- Invariance(
  data = osbornesudick1972,
  time_points = c(1, 6),
  factor_loadings = list(
    c(1, 2, 3, 4)
  )
)
summary(mi)
```

`Weak` *Weak Invariance Model*

Description

Weak Invariance Model

Usage

```
Weak(
  data,
  time_points,
  factor_loadings,
  covariances = FALSE,
  model_add = NULL,
  ...
)
```

Arguments

`data`	Dataframe. The function assumes that the data is in the wide format and the variables are named as follows: `paste0("y", time_point, "_", item_number)`. For example, for the item 1 from the first time point, the variable name should be `y1_1`.
`time_points`	Numeric vector of discrete time points.
`factor_loadings`	List with length equal to the number of factors. Each element of the list is the item number of items for the specific factor.
`covariances`	Logical. If `covariance = TRUE`, model the covariances of the measurement error.
`model_add`	Additional specification added to the lavaan model syntax.
`...`	Additional arguments to pass to `lavaan::cfa()`.

Value

Returns a fitted `lavaan` object.

Author(s)

Ivan Jacob Agaloos Pesigan

See Also

Other Longitudinal Measurement Invariance Functions: `Comparison()`, `Configural()`, `Invariance()`, `Strict()`, `Strong()`

Examples

```
data("osbornesudick1972", package = "longMI")
weak_fit <- Weak(
  data = osbornesudick1972,
  time_points = c(1, 6),
  factor_loadings = list(
    c(1, 2, 3, 4)
  )
)
library(lavaan)
summary(weak_fit)
```

Index