

# Package ‘longMI’

December 13, 2023

**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](https://doi.org/10.4324/9780203821961)>.

**URL** <https://github.com/ijapesigan/longMI>,  
<https://ijapesigan.github.io/longMI/>

**BugReports** <https://github.com/ijapesigan/longMI/issues>

**License** MIT + file LICENSE

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anova.longmi	<i>Model Comparison Method for an Object of Class longmi</i>
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**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)
```

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Comparison

*Compare Measurement Invariance Models*

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## Description

Compare Measurement Invariance Models

## Usage

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

## Arguments

<code>configural</code>	Fitted configural invariance model.
<code>weak</code>	Fitted weak invariance model.
<code>strong</code>	Fitted strong invariance model.
<code>strict</code>	Fitted strict invariance model.
<code>...</code>	Additional arguments to pass to <a href="#">lavaan::lavTestLRT()</a> .

## 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.

**measures** Fit measures.

**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

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

### 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**

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

**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.

**measures** Fit measures.

**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)
```

---

osbornesudick1972	<i>Wechsler Intelligence Scale for Children Data from Osborne and Sudick (1972)</i>
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**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.

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print.longmi	<i>Print Method for an Object of Class longmi</i>
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**Description**

Print Method for an Object of Class longmi

**Usage**

```
## S3 method for class 'longmi'  
print(x, digits = 4, ...)
```

**Arguments**

- x** Object of class longmi that is, the output of the [Invariance\(\)](#) or the [Comparison\(\)](#) functions.
- 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: <code>paste0("y", time_point, "_", item_number)</code> . For example, for the item 1 from the first time point, the variable name should be <code>y1_1</code> .
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 <code>covariance = TRUE</code> , model the covariances of the measurement error.
model_add	Additional specification added to the lavaan model syntax.
...	Additional arguments to pass to <code>lavaan::cfa()</code> .

**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**

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

**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)
```

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summary.longmi	<i>Summary Method for an Object of Class longmi</i>
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## Description

Summary Method for an Object of Class longmi

## Usage

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

## Arguments

object	Object of class longmi that is, the output of the <a href="#">Invariance()</a> or the <a href="#">Comparison()</a> functions.
...	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**

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

**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)
```

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