

Package ‘semptools’

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Title Customizing Structural Equation Modelling Plots

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Description Most function focus on specific ways to customize a graph. They use a 'qgraph' output as the first argument, and return a modified 'qgraph' object. This allows the functions to be chained by a pipe operator.

URL <https://sfcheung.github.io/semptools/>

BugReports <https://github.com/sfcheung/semptools/issues>

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add_object	<i>Add a Fit Object to a 'qgraph' Object</i>
------------	--

Description

Add a fit object (e.g., 'lavaan' output) to the a 'qgraph' object as an attribute.

Usage

```
add_object(semPaths_plot, object)
```

Arguments

semPaths_plot	A <code>qgraph::qgraph</code> object generated by <code>semPlot::semPaths()</code> , or a similar <code>qgraph::qgraph</code> object modified by other <code>semtools</code> functions.
object	Should be the object, such as the output of <code>lavaan::sem()</code> or <code>lavaan::cfa()</code> , used by <code>semPlot::semPaths()</code> to generate <code>semPaths_plot</code> . Note that this function will not check whether the object is appropriate because there is no way to do so reliably.

Details

It adds an object to a [qgraph::qgraph](#) object as the attribute "semptools_fit_object", to be retrieved by other functions that need to access the original output used in [semPlot::semPaths\(\)](#) to create a diagram.

Value

The original [qgraph::qgraph](#) object set to semPaths_plot, with the attribute "semptools_fit_object" set to object.

See Also

[semPlot::semPaths\(\)](#)

Examples

```
library(lavaan)
library(semPlot)

mod <-
  'f1 =~ x01 + x02 + x03 + x06
  f2 =~ x04 + x05 + x06 + x07
  f3 =~ x08 + x09 + x10 + x03
  f4 =~ x11 + x12 + x13 + x14
  '

fit <- lavaan::cfa(mod, cfa_example)
p <- semPaths(fit,
  whatLabels = "est",
  sizeMan = 3.25,
  node.width = 1,
  edge.label.cex = .75,
  mar = c(10, 5, 10, 5),
  DoNotPlot = TRUE)
p <- add_object(p, fit)
attr(p, "semptools_fit_object")
```

 add_rsq

Add R-Squares to Endogenous Variables

Description

Replace the residual variances of exogenous variables by their R-squares in a [qgraph::qgraph](#) object.

Usage

```
add_rsq(semPaths_plot, object, digits = 2L, rsq_string = "R2=", ests = NULL)
```

Arguments

<code>semPaths_plot</code>	A qgraph object generated by <code>semPaths</code> , or a similar qgraph object modified by other <code>semptools</code> functions.
<code>object</code>	The object used by <code>semPaths</code> to generate the plot. Use the same argument name used in <code>semPaths</code> to make the meaning of this argument obvious. Currently only object of class <code>lavaan</code> is supported.
<code>digits</code>	Integer indicating number of decimal places for the R-squares. Default is 2L.
<code>rsq_string</code>	The string before the R-squares. Default is "R2=".
<code>ests</code>	A data.frame from the <code>parameterEstimates</code> function, or from other function with these columns: <code>lhs</code> , <code>op</code> , <code>rhs</code> , and <code>est</code> . The rows with <code>op</code> equal to <code>r2</code> are used to find the R-squares. Only used when <code>object</code> is not specified.

Details

Modify a `qgraph::qgraph` object generated by `semPaths` by setting the labels of the residuals of endogenous variables to their R-squares.

Require either the original object used in the `semPaths` call, or a data frame with the R-square for each endogenous variable.

Currently supports only plots based on `lavaan` output.

Value

If the input is a `qgraph::qgraph` object, the function returns a qgraph based on the original one, with R-squares added. If the input is a list of qgraph objects, the function returns a list of the same length.

Examples

```
mod_pa <-
  'x1 ~~ x2
  x3 ~ x1 + x2
  x4 ~ x1 + x3
  '

fit_pa <- lavaan::sem(mod_pa, pa_example)
lavaan::parameterEstimates(fit_pa)[ , c("lhs", "op", "rhs",
                                         "est", "pvalue", "se")]

m <- matrix(c("x1", NA, NA,
              NA, "x3", "x4",
              "x2", NA, NA), byrow = TRUE, 3, 3)
p_pa <- semPlot::semPaths(fit_pa, whatLabels = "est",
                          style = "ram",
                          nCharNodes = 0, nCharEdges = 0,
                          layout = m)
p_pa2 <- add_rsq(p_pa, fit_pa)
plot(p_pa2)

mod_cfa <-
  'f1 =~ x01 + x02 + x03
  f2 =~ x04 + x05 + x06 + x07
  f3 =~ x08 + x09 + x10'
```

```

    f4 =~ x11 + x12 + x13 + x14
  ,
fit_cfa <- lavaan::sem(mod_cfa, cfa_example)
lavaan::parameterEstimates(fit_cfa)[ , c("lhs", "op", "rhs",
                                         "est", "pvalue", "se")]
p_cfa <- semPlot::semPaths(fit_cfa, whatLabels = "est",
                          style = "ram",
                          nCharNodes = 0, nCharEdges = 0)
# Place standard errors on a new line
p_cfa2 <- add_rsqa(p_cfa, fit_cfa)
plot(p_cfa2)

mod_sem <-
'f1 =~ x01 + x02 + x03
 f2 =~ x04 + x05 + x06 + x07
 f3 =~ x08 + x09 + x10
 f4 =~ x11 + x12 + x13 + x14
 f3 ~ f1 + f2
 f4 ~ f1 + f3
,

# Can be used with mark_se() and mark_sig()
fit_sem <- lavaan::sem(mod_sem, sem_example)
lavaan::parameterEstimates(fit_sem)[ , c("lhs", "op", "rhs",
                                         "est", "pvalue", "se")]
p_sem <- semPlot::semPaths(fit_sem, whatLabels = "est",
                          style = "ram",
                          nCharNodes = 0, nCharEdges = 0)
# Mark significance, and then add standard errors
p_sem2 <- mark_sig(p_sem, fit_sem)
p_sem3 <- mark_se(p_sem2, fit_sem, sep = "\n")
p_sem4 <- add_rsqa(p_sem3, fit_sem)
plot(p_sem4)

```

auto_factor_point_to *Create a Matrix for 'factor_point_to'*

Description

Use a named vector or named arguments to create a matrix of the directions of indicators of factors.

Usage

```
auto_factor_point_to(factor_layout, ...)
```

Arguments

factor_layout Argument description.

... Additional arguments. If the first argument is not named, then it should be a named vector of directions, names being the names of the factors, and directions can be one of these values: "up", "down", "left", "right". Other arguments are ignored. If the arguments are named, then the names of the arguments are the names of the factors, and the argument values are the direction for the factors.

Details

A helper function to make it easier to create the matrix used by `set_sem_layout()` to indicate where the indicators of each factor should be positioned.

It works in two modes. If the first argument is a named vector, such as `c(f1 = "up", f2 = "down")`, then this vector will be used to create the direction matrix.

If the arguments are named, such as `auto_factor_point_to(factor_layout, f1 = "up", f2 = "down")`, then the names are treated as the factor names, and the values of the arguments are treated as the directions.

The matrix created can then be used for the argument `factor_point_to` in `set_sem_layout()`.

Value

A character matrix of the same dimension as `factor_layout`. The cells of factor names are replaced by the directions to place their indicators.

See Also

[set_sem_layout\(\)](#)

Examples

```
factor_layout <- matrix(c("f1", NA, NA,
                        NA, "f3", "f4",
                        "f2", NA, NA), byrow = TRUE, 3, 3)
factor_point_to <- auto_factor_point_to(factor_layout,
                                       f1 = "left",
                                       f2 = "left",
                                       f3 = "down",
                                       f4 = "down")
factor_point_to
```

auto_indicator_order *Determine the Order of Indicators Automatically*

Description

Determine the order of indicators and match indicators and factors based on a plot from a 'qgraph' object.

Usage

```
auto_indicator_order(semPaths_plot, add_isolated_manifest = FALSE)
```

Arguments

`semPaths_plot` A `qgraph::qgraph` object generated by `semPlot::semPaths()`, or a similar `qgraph::qgraph` object modified by other `semtools` functions.

`add_isolated_manifest` Logical. Whether observed variables that are not indicators will be included in the output as "factors", each with one indicator (the observed variable).

Details

It inspects a `qgraph::qgraph` object and find variables that are the indicators of latent factors.

The output can be used in the argument `indicator_order` of `set_cfa_layout()` and `set_sem_layout()`. It can also be modified, such as reordered, as necessary.

If the generated order is used, there is no need to call this function manually because `set_cfa_layout()` and `set_sem_layout()` will automatically call this function, if `indicator_order` is not set.

It assumes that observed variables are represented by squares (shape set to "square") and latent variables represented by circles or ovals (shape set to "circle").

An observed variable is considered as an indicator if there is an arrow pointing to it from a latent variable.

If an indicator loaded on more than one latent variable, it will only be matched to one of them, determined by the order of appearance in the internal storage.

It uses node names, not node labels, in generating the output.

Value

A named character vector. The values are the indicators identified. The names are the latent factors the indicators loaded on.

See Also

`set_sem_layout()` and `set_cfa_layout()`.

Examples

```
library(lavaan)
library(semPlot)

mod <-
  'f1 =~ x01 + x02 + x03 + x06
  f2 =~ x04 + x05 + x06 + x07
  f3 =~ x08 + x09 + x10 + x03
  f4 =~ x11 + x12 + x13 + x14
  '

fit <- lavaan::cfa(mod, cfa_example)
p <- semPaths(fit,
```

```
        whatLabels = "est",
        sizeMan = 3.25,
        node.width = 1,
        edge.label.cex = .75,
        mar = c(10, 5, 10, 5),
        DoNotPlot = TRUE)
indicator_order <- auto_indicator_order(p)
indicator_order
p2 <- set_cfa_layout(p,
                    indicator_order = indicator_order)
plot(p2)

# set_cfa_layout() will call auto_indicator_order()
# automatically if indicator_order is not set.
p3 <- set_cfa_layout(p)
plot(p3)
```

cfa_example

Sample dataset pa_example

Description

A sample dataset for fitting a confirmatory factor analysis model.

Usage

```
cfa_example
```

Format

An object of class `data.frame` with 200 rows and 14 columns.

Details

Fourteen variables (x01 to x14), 200 cases.

Sample model to fit (in [lavaan::model.syntax](#) notation)

```
mod <-
'f1 =~ x01 + x02 + x03
 f2 =~ x04 + x05 + x06 + x07
 f3 =~ x08 + x09 + x10
 f4 =~ x11 + x12 + x13 + x14
'
```

change_node_label *Change node labels*

Description

Change the labels of selected nodes.

Usage

```
change_node_label(
  semPaths_plot,
  label_list = NULL,
  label.cex,
  label.scale,
  label.prop,
  label.norm
)
```

Arguments

- | | |
|---------------|---|
| semPaths_plot | A qgraph::qgraph object generated by semPlot::semPaths , or a similar qgraph object modified by other semptools functions. |
| label_list | A list of named lists. Each named list should have two named values: node and to. The first part, node, is a character denoting the label to be changed. It should be as appeared in the qgraph. The second part, to, is the new label. Expression can be used in to. A named vector can also be used, with the names being the nodes to be changed, and the values the new labels. |
| label.cex | Identical to the same argument in semPlot::semPaths() . A number tha control the size of labels in the nodes. It has no default. If not set, then this option in the semPaths_plot will not be changed. |
| label.scale | Identical to the same argument in semPlot::semPaths . A logical value that determine whether labels will be scaled (resized) to the nodes they attach to. It has no default. If not set, then this option in the semPaths_plot will not be changed. |
| label.prop | Identical to the same argument in semPlot::semPaths . A numeric vector of length equal to the number of nodes. If label.scale is TRUE, this number is the proportion of the width of a node that its label will be scaled (resized) to. It has no default. If not set, then this option in the semPaths_plot will not be changed. |
| label.norm | Identical to the same argument in semPlot::semPaths . It must be a string. All labels as wide as or narrower than this string will have the same font size, while all labels wider than this string will be rescaled to have the same width as this string. It has no default. If not set, then this option in the semPaths_plot will not be changed. |

Details

Modify a `qgraph::qgraph` object generated by `semPlot::semPaths` and change the labels of selected nodes.

Value

A `qgraph::qgraph` based on the original one, with node attributes of selected nodes modified.

Examples

```
library(semPlot)
library(lavaan)
mod_pa <-
  'x1 ~~ x2
  x3 ~ x1 + x2
  x4 ~ x1 + x3
  '
fit_pa <- sem(mod_pa, pa_example)
parameterEstimates(fit_pa)[, c("lhs", "op", "rhs", "est", "pvalue")]
m <- matrix(c("x1", NA, NA,
             NA, "x3", "x4",
             "x2", NA, NA), byrow = TRUE, 3, 3)
p_pa <- semPaths(fit_pa, whatLabels="est",
                style = "ram",
                nCharNodes = 0, nCharEdges = 0,
                layout = m)

my_label_list <- list(list(node = "x3", to = "mediator"),
                    list(node = "x4", to = expression(gamma)))

p_pa2 <- change_node_label(p_pa, my_label_list)
plot(p_pa2)
```

is_dv_residvar

Identify dependent Variable residual variance

Description

Check which parameters in a lavaan output are the residual variance of a dependent variable.

Usage

```
is_dv_residvar(lavaan_out)
```

Arguments

lavaan_out A `lavaan::lavaan` object.

Details

Check which parameters in a lavaan output are the variance of a dependent variable. Indicators of a latent variable will be excluded.

Value

A boolean vector with length equal to the number of rows in the lavaan output.

Examples

```
mod <-
'x1 ~~ x2
x3 ~ x1 + x2
x4 ~ x1 + x3
'
fit_pa <- lavaan::sem(mod, pa_example)
is_dv_residvar(fit_pa)

mod <-
'f1 =~ x01 + x02 + x03
f2 =~ x04 + x05 + x06 + x07
f3 =~ x08 + x09 + x10
f4 =~ x11 + x12 + x13 + x14
'
fit_cfa <- lavaan::cfa(mod, cfa_example)
is_dv_residvar(fit_cfa)

mod <-
'f1 =~ x01 + x02 + x03
f2 =~ x04 + x05 + x06 + x07
f3 =~ x08 + x09 + x10
f4 =~ x11 + x12 + x13 + x14
f3 ~ f1 + f2
f4 ~ f1 + f3
'
fit_sem <- lavaan::sem(mod, sem_example)
is_dv_residvar(fit_sem)
```

keep_drop_nodes

Keep or drop nodes

Description

Keep or drop nodes from an semPlotModel object.

Usage

```
drop_nodes(object, nodes)
```

```
keep_nodes(object, nodes)
```

Arguments

`object` An an `semPlot::semPlotModel` generated by `semPlot::semPlotModel()`.
`nodes` A character vector of the nodes to be kept or removed.

Details

These functions can be used to edit the nodes in an `semPlot::semPlotModel` generated by `semPlot::semPlotModel()`. The edited object can then be passed to `semPlot::semPaths()` to generate a path diagram.

Use `keep_nodes()` to specify the nodes to be kept. All other nodes will be removed.

Use `drop_nodes()` to specify the nodes to be dropped. All other nodes will be kept.

Value

An object of the class `semPlot::semPlotModel`.

Examples

```
mod_pa <-
  'x1 ~~ x2
  x3 ~ x1 + x2
  x4 ~ x1 + x3
  '

fit_pa <- lavaan::sem(mod_pa, pa_example)
m <- matrix(c("x1", NA, NA,
             NA, "x3", "x4",
             "x2", NA, NA), byrow = TRUE, 3, 3)
pm_pa <- semPlot::semPlotModel(fit_pa)
semPlot::semPaths(pm_pa, whatLabels = "est",
                 style = "ram",
                 nCharNodes = 0, nCharEdges = 0,
                 layout = m)
pm_pa2 <- drop_nodes(pm_pa, c("x3"))
semPlot::semPaths(pm_pa2, whatLabels = "est",
                 style = "ram",
                 nCharNodes = 0, nCharEdges = 0,
                 layout = m)
pm_pa3 <- keep_nodes(pm_pa, c("x1", "x3", "x4"))
semPlot::semPaths(pm_pa3, whatLabels = "est",
                 style = "ram",
                 nCharNodes = 0, nCharEdges = 0,
                 layout = m)
```

lavaan_indicator_order

Determine the Order of Indicators Using a 'lavaan' Model Syntax

Description

Determine the order of indicators and match indicators and factors based on a 'lavaan' model syntax.

Usage

```
lavaan_indicator_order(model_syntax)
```

Arguments

`model_syntax` A string that should be a model specified in lavaan model syntax. Only the factor structure (operator `=~`) in the model will be used.

Details

It generates a named vector for the argument `indicator_order` of `set_cfa_layout()` and `set_sem_layout()` using a lavaan model syntax.

A variable is considered an indicator if it is on the right-hand side of the operator `=~`.

If an indicator loaded on more than one latent variable, it will only be matched to one of them, determined by the order of appearance in the internal storage.

Value

A named character vector. The values are the indicators in the model syntax. The names are the latent factors the indicators loaded on.

See Also

[set_sem_layout\(\)](#) and [set_cfa_layout\(\)](#).

Examples

```
mod <-
'f1 =~ x01 + x02 + x03 + x06
  f4 =~ x11 + x12 + x13 + x14
  f2 =~ x04 + x05 + x06 + x07
  f3 =~ x08 + x09 + x10 + x03
'
```

```
lavaan_indicator_order(mod)
```

```
mod <-
'f1 =~ x01 + x02 + x03 + x06
  f3 =~ x08 + x09 + x10 + x03
  f2 =~ x04 + x05 + x06 + x07
  f4 =~ x11 + x12 + x13 + x14
  f3 ~ f1 + f2
  f4 ~ f3
'
```

```
lavaan_indicator_order(mod)
```

layout_matrix	<i>Create the layout matrix for semPaths</i>
---------------	--

Description

Create the layout matrix from a list of coordinates for `semPaths`.

Usage

```
layout_matrix(...)
```

Arguments

... Each node in the matrix is specified by this form: `name = c(x, y)`. The name is the node label, and the vector is the position of the node. The first element is the x position, and the second element is the y position, measured from the top left corner. The size of the grid is determined automatically. For a grid of n rows and m columns, the top left cell is specified by `c(1, 1)`, and the bottom right cell is specified by `c(n, m)`.

Details

The layout argument in `semPlot::semPaths()` accepts a matrix with node labels as the elements, and NA for empty cells. This function allows user to create the matrix using a list of coordinates for the node labels.

Value

A layout matrix for the layout argument of `semPlot::semPaths()`.

Examples

```
# Suppose this is the layout to be created:
m0 <- matrix(c("x1", NA, NA, NA,
              "x2", "x3", NA, NA,
              NA, "x4", NA, "x5"), byrow = TRUE, 3, 4)
# This call will create the same matrix.
m1 <- layout_matrix(x1 = c(1, 1),
                  x2 = c(2, 1),
                  x3 = c(2, 2),
                  x4 = c(3, 2),
                  x5 = c(3, 4))
#The two matrices should be identical.
m0 == m1
```

mark_se	<i>Add Standard Error Estimates to Parameter Estimates (Edge Labels)</i>
---------	--

Description

Add standard error estimates, in parentheses, to parameter estimates (edge labels) in a `qgraph::qgraph` object.

Usage

```
mark_se(
  semPaths_plot,
  object,
  sep = " ",
  digits = 2L,
  ests = NULL,
  std_type = FALSE
)
```

Arguments

<code>semPaths_plot</code>	A <code>qgraph</code> object generated by <code>semPaths</code> , or a similar <code>qgraph</code> object modified by other <code>semptools</code> functions.
<code>object</code>	The object used by <code>semPaths</code> to generate the plot. Use the same argument name used in <code>semPaths</code> to make the meaning of this argument obvious. Currently only object of class <code>lavaan</code> is supported.
<code>sep</code>	A character string to separate the coefficient and the standard error (in parentheses). Default to " " (one space). Use "\n" to enforce a line break.
<code>digits</code>	Integer indicating number of decimal places for the appended standard errors. Default is 2L.
<code>ests</code>	A data.frame from the <code>parameterEstimates</code> function, or from other function with these columns: lhs, op, rhs, and se. Only used when <code>object</code> is not specified.
<code>std_type</code>	If standardized solution is used in the plot, set this either to the type of standardization (e.g., "std.all") or to TRUE. It will be passed to <code>lavaan::standardizedSolution()</code> to compute the standard errors for the standardized solution. Used only if standard errors are not supplied directly through <code>ests</code> .

Details

Modify a `qgraph::qgraph` object generated by `semPaths` (currently in parentheses) to the labels. Require either the original object used in the `semPaths` call, or a data frame with the standard error for each parameter. The latter option is for standard errors not computed by `lavaan` but by other functions.

Currently supports only plots based on `lavaan` output.

This function is a variant of, and can be combined with, the `mark_sig` function.


```

p_sem <- semPlot::semPaths(fit_sem, whatLabels = "est",
                          style = "ram",
                          nCharNodes = 0, nCharEdges = 0)
# Mark significance, and then add standard errors
p_sem2 <- mark_sig(p_sem, fit_sem)
p_sem3 <- mark_se(p_sem2, fit_sem, sep = "\n")
plot(p_sem3)

```

mark_sig

Mark Parameter Estimates (Edge Labels) Based on p-Value

Description

Mark parameter estimates (edge labels) based on p-value.

Usage

```

mark_sig(
  semPaths_plot,
  object,
  alphas = c(`*` = 0.05, `**` = 0.01, `***` = 0.001),
  ests = NULL,
  std_type = FALSE
)

```

Arguments

- | | |
|---------------|---|
| semPaths_plot | A qgraph::qgraph object generated by <code>semPaths</code> , or a similar <code>qgraph</code> object modified by other semptools functions. |
| object | The object used by <code>semPaths</code> to generate the plot. Use the same argument name used in <code>semPaths</code> to make the meaning of this argument obvious. Currently only object of class <code>lavaan</code> is supported. |
| alphas | A named numeric vector. Each element is the cutoff (level of significance), and the name of it is the symbol to be used if p-value is less than this cutoff. The default is <code>c("", ".05", ".01", ".001")</code> . |
| ests | A data.frame from the parameterEstimates function, or from other function with these columns: <code>lhs</code> , <code>op</code> , <code>rhs</code> , and <code>pvalue</code> . Only used when <code>object</code> is not specified. |
| std_type | If standardized solution is used in the plot, set this either to the type of standardization (e.g., <code>"std.all"</code>) or to <code>TRUE</code> . It will be passed to lavaan::standardizedSolution() to compute the standard errors for the standardized solution. Used only if standard errors are not supplied directly through <code>ests</code> . |

Details

Modify a `qgraph::qgraph` object generated by `semPaths` and add marks (currently asterisk, "*") to the labels based on their p-values. Require either the original object used in the `semPaths` call, or a data frame with the p-values for each parameter. The latter option is for p-values not computed by `lavaan` but by other functions.

Currently supports only plots based on `lavaan` output.

Value

A `qgraph::qgraph` based on the original one, with marks appended to edge labels based on their p-values.

Examples

```
mod_pa <-
  'x1 ~~ x2
  x3 ~ x1 + x2
  x4 ~ x1 + x3
  '
fit_pa <- lavaan::sem(mod_pa, pa_example)
lavaan::parameterEstimates(fit_pa)[, c("lhs", "op", "rhs", "est", "pvalue")]
m <- matrix(c("x1", NA, NA,
              NA, "x3", "x4",
              "x2", NA, NA), byrow = TRUE, 3, 3)
p_pa <- semPlot::semPaths(fit_pa, whatLabels="est",
                          style = "ram",
                          nCharNodes = 0, nCharEdges = 0,
                          layout = m)
p_pa2 <- mark_sig(p_pa, fit_pa)
plot(p_pa2)

mod_cfa <-
  'f1 =~ x01 + x02 + x03
  f2 =~ x04 + x05 + x06 + x07
  f3 =~ x08 + x09 + x10
  f4 =~ x11 + x12 + x13 + x14
  '
fit_cfa <- lavaan::sem(mod_cfa, cfa_example)
lavaan::parameterEstimates(fit_cfa)[, c("lhs", "op", "rhs", "est", "pvalue")]
p_cfa <- semPlot::semPaths(fit_cfa, whatLabels="est",
                          style = "ram",
                          nCharNodes = 0, nCharEdges = 0)
p_cfa2 <- mark_sig(p_cfa, fit_cfa)
plot(p_cfa2)

mod_sem <-
  'f1 =~ x01 + x02 + x03
  f2 =~ x04 + x05 + x06 + x07
  f3 =~ x08 + x09 + x10
  f4 =~ x11 + x12 + x13 + x14
  f3 ~ f1 + f2
  '
```

```
f4 ~ f1 + f3
',
fit_sem <- lavaan::sem(mod_sem, sem_example)
lavaan::parameterEstimates(fit_sem)[, c("lhs", "op", "rhs", "est", "pvalue")]
p_sem <- semPlot::semPaths(fit_sem, whatLabels="est",
  style = "ram",
  nCharNodes = 0, nCharEdges = 0)
p_sem2 <- mark_sig(p_sem, fit_sem)
plot(p_sem2)
```

pa_example

Sample dataset pa_example

Description

A sample dataset for fitting a path analysis model.

Usage

```
pa_example
```

Format

An object of class `data.frame` with 100 rows and 4 columns.

Details

Four variables (x1 to x4), 100 cases.

Sample model to fit (in `lavaan::model.syntax` notation)

```
mod <-
'x1 ~~ x2
x3 ~ x1 + x2
x4 ~ x1 + x3
'
```

pa_example_3covs *Sample dataset pa_example_3covs*

Description

A sample dataset for fitting a path analysis model, with three control variables.

Usage

```
pa_example_3covs
```

Format

An object of class `data.frame` with 100 rows and 7 columns.

Details

Four variables (x1 to x4), and three control variables (cov1, cov2, cov3), 100 cases.

Sample model to fit (in `lavaan::model.syntax` notation)

```
mod <-
'|
x3 ~ x1 + x2 + cov1 +cov2 + cov3
x4 ~ x1 + x3 + cov1 +cov2 + cov3
'|
```

rescale_layout *Rescale the Layout*

Description

Rescale the layout of a `qgraph` object, such as the output of `semptools` functions that modify the output of `semPlot::semPaths()`.

Usage

```
rescale_layout(semPaths_plot, x_min = -1, x_max = 1, y_min = -1, y_max = 1)
```

Arguments

`semPaths_plot` A `qgraph::qgraph` object generated by `semPlot::semPaths()`, or a similar `qgraph` object modified by other `semptools` functions.

`x_min, x_max, y_min, y_max`

The ranges of x-coordinates and y-coordinates after rescaling. Default is -1 for `x_min` and `y_min`, and 1 for `x_max` and `y_max`. Change them to enlarge or shrink the plot.

Details

The plot generated by some functions, such as `set_sem_layout()`, may have the area underused for some model. This function rescale the layout matrix, just like what the `rescale` argument of `semPlot::semPaths()` does.

Value

A `qgraph::qgraph` based on the original one, with the layout matrix rescaled.

Examples

```
library(lavaan)
library(semPlot)
mod <-
  'f1 =~ x01 + x02 + x03
  f3 =~ x08 + x09 + x10
  f4 =~ x11 + x12 + x13 + x14
  f3 ~ f1 + x04
  f4 ~ f3 + x05'
fit_sem <- sem(mod, sem_example)
p <- semPaths(fit_sem, whatLabels="est",
             sizeMan = 5,
             nCharNodes = 0,
             nCharEdges = 0,
             edge.width = 0.8,
             node.width = 0.7,
             edge.label.cex = 0.6,
             mar = c(10, 10, 10, 10),
             DoNotPlot = TRUE)

plot(p)

indicator_order <- c("x04", "x05", "x01", "x02", "x03",
                  "x11", "x12", "x13", "x14", "x08", "x09", "x10")
indicator_factor <- c("x04", "x05", "f1", "f1", "f1",
                  "f4", "f4", "f4", "f4", "f3", "f3", "f3")
factor_layout <- matrix(c("f1", "f3", "f4",
                        "x04", "x05", NA), byrow = TRUE, 2, 3)
factor_point_to <- matrix(c("left", "up", "right",
                          NA, NA, NA), byrow = TRUE, 2, 3)

p2 <- set_sem_layout(p,
                    indicator_order = indicator_order,
                    indicator_factor = indicator_factor,
                    factor_layout = factor_layout,
                    factor_point_to = factor_point_to)

# The original plot with too much unused area
plot(p2)
rect(-1, -1, 1, 1)
rect(-1.5, -1.5, 1.5, 1.5)

# Expand the plot
p3 <- p2
p3 <- rescale_layout(p3)
```

```
plot(p3)
rect(-1, -1, 1, 1)
rect(-1.5, -1.5, 1.5, 1.5)
```

 rotate_resid

Rotate the residuals of selected nodes

Description

Rotate the residuals of selected nodes.

Usage

```
rotate_resid(semPaths_plot, rotate_resid_list = NULL)
```

Arguments

`semPaths_plot` A [qgraph::qgraph](#) object generated by [semPlot::semPaths](#), or a similar qgraph object modified by other [semptools](#) functions.

`rotate_resid_list`

A named vector or a list of named list. For a named vector, the name of an element is the node for which its residual is to be rotated, and the value is the degree to rotate. The 12 o'clock position is zero degree. Positive degree denotes clockwise rotation, and negative degree denotes anticlockwise rotation. For example, `c(x3 = 45, x4 = -45)` means rotating the residual of x3 45 degrees clockwise, and rotating the residual of x4 45 degrees anticlockwise. For a list of named lists, each named list should have two named values: `node` and `rotate`. The position of the residual of node will be placed at rotate, in degree. For example, `list(list(node = "x3", rotate = 45), list(node = "x4", rotate = -45))` is equivalent to `c(x3 = 45, x4 = -45)`.

Details

Modify a [qgraph::qgraph](#) object generated by [semPlot::semPaths](#) and rotate the residuals of selected nodes. Currently only supports "ram" and similar styles of [semPlot::semPaths](#).

Value

A [qgraph::qgraph](#) object based on the original one, with `loopRotation` attributes of selected nodes modified.

Examples

```

mod_pa <-
  'x1 ~~ x2
  x3 ~ x1 + x2
  x4 ~ x1 + x3
  '

fit_pa <- lavaan::sem(mod_pa, pa_example)
lavaan::parameterEstimates(fit_pa)[, c("lhs", "op", "rhs", "est", "pvalue")]
m <- matrix(c("x1", NA, NA,
             NA, "x3", "x4",
             "x2", NA, NA), byrow = TRUE, 3, 3)
p_pa <- semPlot::semPaths(fit_pa, whatLabels="est",
                          style = "ram",
                          nCharNodes = 0, nCharEdges = 0,
                          layout = m)

my_rotate_resid_vector <- c(x3 = 45, x4 = -45)

p_pa2v <- rotate_resid(p_pa, my_rotate_resid_vector)
plot(p_pa2v)

my_rotate_resid_list <- list(list(node = "x3", rotate = 45),
                             list(node = "x4", rotate = -45))

p_pa2l <- rotate_resid(p_pa, my_rotate_resid_list)
plot(p_pa2l)

```

sem_2nd_order_example *Sample dataset sem_2nd_order_example*

Description

A sample dataset for fitting a latent variable model with two 2nd-order factors.

Usage

```
sem_2nd_order_example
```

Format

An object of class `data.frame` with 500 rows and 21 columns.

Details

Twenty one variables (x01 to x21), 500 cases.

Sample model to fit (in `lavaan::model.syntax` notation)

```
mod <-  
'f1 =~ x01 + x02 + x03  
f2 =~ x04 + x05 + x06 + x07  
f3 =~ x08 + x09 + x10  
f4 =~ x11 + x12 + x13 + x14  
f5 =~ x15 + x16 + x17 + x18  
f6 =~ x19 + x20 + x21  
f21 =~ 1*f1 + f3 + f4  
f22 =~ 1*f2 + f5 + f6  
f22 ~ f21  
,
```

sem_example

Sample dataset sem_example

Description

A sample dataset for fitting a latent variable model.

Usage

```
sem_example
```

Format

An object of class `data.frame` with 200 rows and 14 columns.

Details

Fourteen variables (x01 to x14), 100 cases.

Sample model to fit (in [lavaan::model.syntax](#) notation)

```
mod <-  
'f1 =~ x01 + x02 + x03  
f2 =~ x04 + x05 + x06 + x07  
f3 =~ x08 + x09 + x10  
f4 =~ x11 + x12 + x13 + x14  
f3 ~ f1 + f2  
f4 ~ f1 + f3  
,
```

set_cfa_layout	<i>Configure the layout of factors of a CFA graph by semPaths</i>
----------------	---

Description

Configure the layout of factors and adjust other aspects of a CFA graph by semPaths.

Usage

```
set_cfa_layout(
  semPaths_plot,
  indicator_order = NULL,
  indicator_factor = NULL,
  fcov_curve = 0.4,
  loading_position = 0.5,
  point_to = "down"
)
```

Arguments

- semPaths_plot** A [qgraph::qgraph](#) object generated by semPaths, or a similar qgraph object modified by other [semptools](#) functions.
- indicator_order** A string vector of the indicators. The order of the names is the order of the indicators in the graph, when they are drawn on the bottom of the graph. The indicators should be grouped by the factors on which they load on. For example, if x1, x2, x4 load on f2, and x3, x5, x6 load on f1, then vector should be either c("x1", "x2", "x4", "x3", "x5", "x6") or c("x3", "x5", "x6", "x1", "x2", "x4"). Indicators within a group can be ordered in any way. If it is a named vector, its names will be used for the argument indicator_factor. If it is NULL (default), [auto_indicator_order\(\)](#) will be called to determine the indicator order automatically.
- indicator_factor** A string vector of the same length of the indicator order, storing the name of the factor for which each of the indicator in indicator_order loads on. For example, if x1, x2, x4 load on f2, and x3, x5, x6 load on f1, and indicator_order is c("x3", "x5", "x6", "x1", "x2", "x4"), then indicator_factor should be c("f2", "f2", "f2", "f1", "f1", "f1"). If NULL (default) and indicator_order is a named vector (supplied by users or generated by [auto_indicator_order\(\)](#)), then it will be set to the names of indicator_order.
- fcov_curve** A number used to set the curvature of the inter-factor covariances. Default is .4.
- loading_position** The positions of all factor loadings. Default is .5, on the middle of the arrows. Larger the number, closer the loadings to the indicators. Smaller the number, closer the loadings to the factors.
- point_to** Can be "down", "left", "up", or "right". Specify the direction that the factors "point" to the indicators. Default is "down".

Details

Modify a `qgraph::qgraph` object generated by `semPaths` based on a confirmatory factor analysis model.

Value

A `qgraph::qgraph` based on the original one, with various aspects of the model modified.

Examples

```
library(lavaan)
library(semPlot)
mod <-
  'f1 =~ x01 + x02 + x03
  f2 =~ x04 + x05 + x06 + x07
  f3 =~ x08 + x09 + x10
  f4 =~ x11 + x12 + x13 + x14
  '
fit_cfa <- lavaan::sem(mod, cfa_example)
lavaan::parameterEstimates(fit_cfa)[, c("lhs", "op", "rhs", "est", "pvalue")]
p <- semPaths(fit_cfa, whatLabels="est",
  sizeMan = 2.5,
  nCharNodes = 0, nCharEdges = 0,
  edge.width = 0.8, node.width = 0.7,
  edge.label.cex = 0.6,
  style = "ram",
  mar = c(10,10,10,10))
indicator_order <- c("x04", "x05", "x06", "x07", "x01", "x02", "x03", "x11",
  "x12", "x13", "x14", "x08", "x09", "x10")
indicator_factor <- c("f2", "f2", "f2", "f2", "f1", "f1", "f1", "f4",
  "f4", "f4", "f4", "f3", "f3", "f3")
p2 <- set_cfa_layout(p, indicator_order,
  indicator_factor,
  fcov_curve = 1.5,
  loading_position = .8)
plot(p2)

# Use a named vector for indicator_order
indicator_order2 <- c(f2 = "x04", f2 = "x05", f2 = "x06", f2 = "x07",
  f1 = "x01", f1 = "x02", f1 = "x03",
  f4 = "x11", f4 = "x12", f4 = "x13", f4 = "x14",
  f3 = "x08", f3 = "x09", f3 = "x10")
p2 <- set_cfa_layout(p,
  indicator_order = indicator_order2,
  fcov_curve = 1.5,
  loading_position = .8)
plot(p2)

# Use automatically generated indicator_order and indicator_factor
p2 <- set_cfa_layout(p,
  fcov_curve = 1.5,
  loading_position = .8)
```

```

plot(p2)

p2 <- set_cfa_layout(p, indicator_order,
                    indicator_factor,
                    fcov_curve = 1.5,
                    loading_position = .8,
                    point_to = "left")

plot(p2)
p2 <- set_cfa_layout(p, indicator_order,
                    indicator_factor,
                    fcov_curve = 1.5,
                    loading_position = .8,
                    point_to = "up")

plot(p2)
p2 <- set_cfa_layout(p, indicator_order,
                    indicator_factor,
                    fcov_curve = 1.5,
                    loading_position = .8,
                    point_to = "right")

plot(p2)

```

set_curve

Bend or Straighten Selected edges

Description

Set the curve attributes of selected edges.

Usage

```
set_curve(semPaths_plot, curve_list = NULL)
```

Arguments

- `semPaths_plot` A [qgraph::qgraph](#) object generated by [semPlot::semPaths](#), or a similar qgraph object modified by other [semptools](#) functions.
- `curve_list` A named vector or a list of named list. For a named vector, the name of an element should be the path as specified by [lavaan::model.syntax](#) or as appeared in [lavaan::parameterEstimates\(\)](#). For example, to change the curve attribute of the path regressing y on x, the name should be "y ~ x". To change the curve attribute of the covariance between x1 and x2, the name should be "x1 ~~ x2". For example, `c("y ~ x1" = -3, "x1 ~~ x2" = 2)` change the curve attributes of the path from x1 to y and the covariance between x1 and x2 to -3 and 2, respectively. The order of the two nodes *may* matter for covariances. Therefore, if the curve of a covariance is not changed, try switching the order of the two nodes. For a list of named lists, each named list should have three named values: `from`, `to`, and `new_curve`. The curve attribute of the edge from `from` to `to` will be set to `new_curve`.

Details

Modified a `qgraph::qgraph` object generated by `semPlot::semPaths` and change the curve attributes of selected edges.

Value

A `qgraph::qgraph` based on the original one, with curve attributes for selected edges changed.

Examples

```
mod_pa <-
'x1 ~~ x2
  x3 ~ x1 + x2
  x4 ~ x1 + x3
,

fit_pa <- lavaan::sem(mod_pa, pa_example)
lavaan::parameterEstimates(fit_pa)[, c("lhs", "op", "rhs", "est", "pvalue")]
m <- matrix(c("x1", NA, NA,
             NA, "x3", "x4",
             "x2", NA, NA), byrow = TRUE, 3, 3)
p_pa <- semPlot::semPaths(fit_pa, whatLabels="est",
                         style = "ram",
                         nCharNodes = 0, nCharEdges = 0,
                         layout = m)

my_curve_vector <- c("x2 ~~ x1" = -1,
                    "x4 ~ x1" = 1)

p_pa2v <- set_curve(p_pa, my_curve_vector)
plot(p_pa2v)

my_curve_list <- list(list(from = "x1", to = "x2", new_curve = -1),
                     list(from = "x1", to = "x4", new_curve = 1))

p_pa2l <- set_curve(p_pa, my_curve_list)
plot(p_pa2l)
```

set_edge_attribute *Set the Attributes of Selected Edges*

Description

Set arbitrary attributes of selected edges.

Usage

```
set_edge_attribute(semPaths_plot, values = NULL, attribute_name = NULL)
```



```

        layout = m)

my_values_vector <- c("x2 ~~ x1" = "red",
                    "x4 ~ x1" = "blue")

p_pa2v <- set_edge_attribute(p_pa,
                           values = my_values_vector,
                           attribute_name = "color")

plot(p_pa2v)

my_values_list <- list(list(from = "x1", to = "x2", new_value = "red"),
                      list(from = "x1", to = "x4", new_value = "blue"))

p_pa2l <- set_edge_attribute(p_pa,
                           values = my_values_list,
                           attribute_name = "color")

plot(p_pa2l)

```

set_edge_color

Set the Colors of Selected Edges

Description

Set the colors of selected edges.

Usage

```
set_edge_color(semPaths_plot, color_list = NULL)
```

Arguments

`semPaths_plot` A [qgraph::qgraph](#) object generated by [semPlot::semPaths](#), or a similar [qgraph](#) object modified by other [semptools](#) functions.

`color_list` A named vector or a list of named list. See the Details section on how to set this argument.

Details

Modified a [qgraph::qgraph](#) object generated by [semPlot::semPaths](#) and change the colors of selected edges.

Setting the value of `color_list`:

This argument can be set in two ways.

For a named vector, the name of an element should be the path as specified by [lavaan::model.syntax](#) or as appeared in [lavaan::parameterEstimates\(\)](#).

For example, to change the color of the path regressing y on x , the name should be " $y \sim x$ ". To change the color of the covariance between x_1 and x_2 , the name should be " $x_1 \sim x_2$ ". Therefore,

`c("y ~ x1" = "red", "x1 ~~ x2" = "blue")` changes the colors of the path from x1 to y and the covariance between x1 and x2 to "red" and "blue", respectively.

The order of the two nodes *may* matter for covariances. Therefore, if the attribute of a covariance is not changed, try switching the order of the two nodes.

For a list of named lists, each named list should have three named values: from, to, and new_color. The attribute of the edge from from to to will be set to new_color.

The second approach is no longer recommended, though kept for backward compatibility.

Value

A `qgraph::qgraph` based on the original one, with colors for selected edges changed.

Examples

```
mod_pa <-
  'x1 ~~ x2
  x3 ~ x1 + x2
  x4 ~ x1 + x3
  '

fit_pa <- lavaan::sem(mod_pa, pa_example)
lavaan::parameterEstimates(fit_pa)[, c("lhs", "op", "rhs", "est", "pvalue")]
m <- matrix(c("x1", NA, NA,
              NA, "x3", "x4",
              "x2", NA, NA), byrow = TRUE, 3, 3)
p_pa <- semPlot::semPaths(fit_pa, whatLabels="est",
  style = "ram",
  nCharNodes = 0, nCharEdges = 0,
  layout = m)

my_color_vector <- c("x2 ~~ x1" = "red",
  "x4 ~ x1" = "blue")

p_pa2v <- set_edge_color(p_pa, my_color_vector)
plot(p_pa2v)

my_color_list <- list(list(from = "x1", to = "x2", new_color = "red"),
  list(from = "x1", to = "x4", new_color = "blue"))

p_pa2l <- set_edge_color(p_pa, my_color_list)
plot(p_pa2l)
```

set_edge_label_position

Set the positions of edge labels of selected edges

Description

Set the positions of edge labels of selected edges.

Usage

```
set_edge_label_position(semPaths_plot, position_list = NULL)
```

Arguments

- `semPaths_plot` A `qgraph::qgraph` object generated by `semPlot::semPaths`, or a similar `qgraph` object modified by other `semtools` functions.
- `position_list` A named vector or a list of named lists. For a named vector, the name of an element should be the path as specified by `lavaan::model.syntax` or as appeared in `lavaan::parameterEstimates()`. For example, to change position of the edge label of the path regressing y on x , the name should be `"y ~ x"`. The value is the position. The mid-point of the edge is 0.5. The closer the value to 1, the closer the label to the left-hand-side node (y in this example). The closer the value to 0, the closer the label to the right-hand-side node (x in this example). For example, `c("y ~ x1" = .2, "y ~ x2" = .7)` moves the path coefficient from x_1 to y closer to x , and the path coefficient from x_2 to y closer to y . For a list of named lists, each named list should have three named values: `from`, `to`, and `new_position`. The edge label position of the edge from `from` to `to` will be set to `new_position`. For example, `list(list(from = "x1", to = "y", new_position = .2), list(from = "x2", to = "y", new_position = .7))` is equivalent to the named vector above.

Details

Modify a `qgraph::qgraph` object generated by `semPlot::semPaths` and change the edge label positions of selected edges.

Value

A `qgraph::qgraph` based on the original one, with edge label positions for selected edges changed.

Examples

```
mod_pa <-
  'x1 ~~ x2
  x3 ~ x1 + x2
  x4 ~ x1 + x3
  '
fit_pa <- lavaan::sem(mod_pa, pa_example)
lavaan::parameterEstimates(fit_pa)[, c("lhs", "op", "rhs", "est", "pvalue")]
m <- matrix(c("x1", NA, NA,
             NA, "x3", "x4",
             "x2", NA, NA), byrow = TRUE, 3, 3)
p_pa <- semPlot::semPaths(fit_pa, whatLabels="est",
                         style = "ram",
                         nCharNodes = 0, nCharEdges = 0,
                         layout = m)

my_position_vector <- c("x3 ~ x2" = .25,
                      "x4 ~ x1" = .75)
```



```

p_pa2v <- set_edge_label_position(p_pa, my_position_vector)
plot(p_pa2v)

my_position_list <- list(list(from = "x2", to = "x3", new_position = .25),
                        list(from = "x1", to = "x4", new_position = .75))
p_pa2l <- set_edge_label_position(p_pa, my_position_list)
plot(p_pa2l)

```

set_node_attribute *Set the Attributes of Selected Nodes*

Description

Set arbitrary attributes of selected nodes

Usage

```
set_node_attribute(semPaths_plot, values = NULL, attribute_name = NULL)
```

Arguments

`semPaths_plot` A `qgraph::qgraph` object generated by `semPlot::semPaths`, or a similar `qgraph` object modified by other `semtools` functions.

`values` A named vector or a list of named list. See the Details section on how to set this argument.

`attribute_name` The name of the attribute to be changed.

Details

Modify a `qgraph::qgraph` object generated by `semPlot::semPaths` and change the selected attributes of selected nodes.

This function is designed to be a general one that changes the attributes named by the user. The user needs to make sure that the attribute actually exists, and the values are valid for the named attribute.

Setting the value of values:

This argument can be set in two ways.

For a named vector, the name of an element should be the nodes for which their attributes are to be changed. The names need to be the *displayed names* if plotted, which may be different from the names in mode.

For example, if the attributes to be changed are the colors of selected nodes, to change the color of `x` is to be changed, the name should be `"x"`. Therefore, `c("y" = "red", "x" = "red")` changes the colors of the nodes `y` and `x` to `"red"` and `"blue"`, respectively.

For a list of named lists, each named list should have two named values: `node` and `new_value`. The attribute of `node` will be set to `new_value`.

The second approach is no longer recommended, though kept for backward compatibility.

Value

A `qgraph::qgraph` based on the original one, with the selected attributes of selected nodes changed.

Examples

```

mod_pa <-
  'x1 ~~ x2
  x3 ~ x1 + x2
  x4 ~ x1 + x3
  '

fit_pa <- lavaan::sem(mod_pa, pa_example)
lavaan::parameterEstimates(fit_pa)[, c("lhs", "op", "rhs", "est", "pvalue")]
m <- matrix(c("x1", NA, NA,
             NA, "x3", "x4",
             "x2", NA, NA), byrow = TRUE, 3, 3)
p_pa <- semPlot::semPaths(fit_pa, whatLabels="est",
                          style = "ram",
                          nCharNodes = 0, nCharEdges = 0,
                          layout = m)

my_color_vector <- c(x3 = "red", x4 = "blue")

p_pa2v <- set_node_attribute(p_pa, my_color_vector, attribute_name = "color")
plot(p_pa2v)

my_color_list <- list(list(node = "x3", new_value = "green"),
                      list(node = "x4", new_value = "red"))

p_pa2l <- set_node_attribute(p_pa, my_color_list, attribute_name = "color")
plot(p_pa2l)

```

 set_sem_layout

Configure the layout of factors of an SEM graph by [semPlot::semPaths](#)

Description

Configure the layout of factors and adjust other aspects of an SEM graph by [semPlot::semPaths](#).

Usage

```

set_sem_layout(
  semPaths_plot,
  indicator_order = NULL,
  indicator_factor = NULL,
  factor_layout = NULL,
  factor_point_to = NULL,
  indicator_push = NULL,
  indicator_spread = NULL,

```

```

    loading_position = 0.5
  )

```

Arguments

- semPaths_plot** A `qgraph::qgraph` object generated by `semPaths`, or a similar `qgraph` object modified by other `semptools` functions.
- indicator_order** A string vector of the indicators. The order of the names is the order of the indicators in the graph, when they are drawn on the bottom of the graph. The indicators should be grouped by the factors on which they load on. For example, if `x1`, `x2`, `x4` load on `f2`, and `x3`, `x5`, `x6` load on `f1`, then vector should be either `c("x1", "x2", "x4", "x3", "x5", "x6")` or `c("x3", "x5", "x6", "x1", "x2", "x4")`. Indicators within a group can be ordered in any way. If it is a named vector, its names will be used for the argument `indicator_factor`. If it is `NULL` (default), `auto_indicator_order()` will be called to determine the indicator order automatically.
- indicator_factor** A string vector of the same length of the indicator order, storing the name of the factor for which each of the indicator in `indicator_order` loads on. For example, if `x1`, `x2`, `x4` load on `f2`, and `x3`, `x5`, `x6` load on `f1`, and `indicator_order` is `c("x3", "x5", "x6", "x1", "x2", "x4")`, then `indicator_factor` should be `c("f2", "f2", "f2", "f1", "f1", "f1")`. If `NULL` (default) and `indicator_order` is a named vector (supplied by users or generated by `auto_indicator_order()`), then it will be set to the names of `indicator_order`.
- factor_layout** A matrix of arbitrary size. This matrix will serve as a grid for users to specify where each latent factor should be placed approximately on the graph. Each cell should contain `NA` or the name of a latent factor. The locations of all latent factors must be explicitly specified by this matrix.
- factor_point_to** Can be a named character vector with names being the names of factors, or a matrix of the same size as `factor_layout`. If it is a matrix, this matrix specifies where the indicators of each factor are positioned. Each cell should contain `NA` or one of these strings: "down", "left", "up", or "right". This is the direction that the corresponding latent factor (specified in `factor_layout`) points to its indicators. If it is a named character vector, the the values must be the directions, and the names the the factors. This vector will be converted internally by `auto_factor_point_to()` to create the matrix of direction.
- indicator_push** (Optional) This argument is used to adjust the positions of the indicators of selected latent factors. It can be named vector or a list of named lists. For a named vector, The name is the factor of which the indicators will be "pushed", and the value is how "hard" the push is: the multiplier to the distance from the factor to the indicators. If this value is 1, then there is no change. If this value is greater than 1, then the indicators are pushed away from the latent factor. If this value is less than 1, then the indicators are pulled toward the latent factor. For example, to push the indicators of `f3` away from `f3`, and pull the indicators of `f4` toward `f4`, the argument can be set to `c(f3 = 1.5, f4 = .5)`. For a list of named list, each named list has two named elements: `node`, the name of a latent factor,

and push, how the positions of its indicators will be adjusted. For example, to have the same effect as the vector above, the list is `list(list(node = "f3", push = 1.5), list(node = "f4", push = .5))`.

indicator_spread

(Optional) This argument is used to adjust the distance between indicators of selected latent factors. It can be a named vector or a list of named lists. For a named vector, the name is the factor of which the indicators will be spread out. The value is the multiplier to the distance between neighboring indicators. If this value is equal to 1, there is no change. Larger than one, the indicators will be "spread" away from each other. Less than one, the indicators will be placed closer to each others. For example, to spread the indicators of f1 and f4 farther away from each other, this argument can be set to `c(f1 = 2, f4 = 1.5)`, with the indicators of f1 being spread out more than those of f4. For a list of named list, each named list has two named elements: `node`, the name of a latent factor, and `spread`, how the distance between indicators will be adjusted. For example, to have the same effect as the vector above, the argument can be set to `list(list(node = "f1", spread = 2), list(node = "f4", spread = 1.5))`.

loading_position

(Optional) Default is `.5`. This is used adjust the position of the loadings. If this is one single number, it will be used to set the positions of all loadings. If it is `.5`, the loadings are placed on the center of the arrows. Larger the number, closer the loadings to the indicators. Smaller the number, closer to the latent factors. This argument also accepts a named vector or a list of named lists, allowing users to specify the positions of loadings for each factor separately. For a named vector, in each element, the name is the factor whose loadings will be moved. The value is the positions of its loadings. The default is `.50`. We only need to specify the positions for factors to be changed from `.50` to other values. For example, move the loadings of f2 closer to the indicators and those of f4 close to the f4, this argument can be set to `c(f2 = .7, f4 = .3)`. For a list of named list, each named list should have two named elements: `node`, the name of the latent factor, and `position`, the positions of all loadings of this factors. To have the same effect as the vector above, this list can be used: `list(list(node = "f2", position = .7), list(node = "f4", position = .3))`.

Details

Modify a `qgraph::qgraph` object generated by `semPaths` based on an SEM model with latent factors. Since version 0.2.9.5, this function natively supports observed exogenous variable. If a variable is listed in both `indicator_order` and `indicator_factor`, as if it is both a factor and an indicator, this function will assume that it is an observed exogenous variable. It will be positioned as a factor according to `factor_layout`, but no indicators will be drawn.

For versions older than 0.2.9.5, an observed exogenous variable needs to be specified as an one-indicator factor in the model specification for this function to work.

Value

A `qgraph::qgraph` based on the original one, with various aspects of the model modified.

Examples

```

library(lavaan)
library(semPlot)
mod <-
'f1 =~ x01 + x02 + x03
f2 =~ x04 + x05 + x06 + x07
f3 =~ x08 + x09 + x10
f4 =~ x11 + x12 + x13 + x14
f3 ~ f1 + f2
f4 ~ f1 + f3
,

fit_sem <- lavaan::sem(mod, sem_example)
lavaan::parameterEstimates(fit_sem)[, c("lhs", "op", "rhs", "est", "pvalue")]
p <- semPaths(fit_sem, whatLabels="est",
  sizeMan = 5,
  nCharNodes = 0, nCharEdges = 0,
  edge.width = 0.8, node.width = 0.7,
  edge.label.cex = 0.6,
  style = "ram",
  mar = c(10,10,10,10))
indicator_order <- c("x04", "x05", "x06", "x07", "x01", "x02", "x03",
  "x11", "x12", "x13", "x14", "x08", "x09", "x10")
indicator_factor <- c("f2", "f2", "f2", "f2", "f1", "f1", "f1",
  "f4", "f4", "f4", "f4", "f3", "f3", "f3")
factor_layout <- matrix(c("f1", NA, NA,
  NA, "f3", "f4",
  "f2", NA, NA), byrow = TRUE, 3, 3)
factor_point_to <- matrix(c("left", NA, NA,
  NA, "down", "down",
  "left", NA, NA), byrow = TRUE, 3, 3)
indicator_push <- c(f3 = 2, f4 = 1.5)
indicator_spread <- c(f1 = 2, f2 = 2)
loading_position <- c(f1 = .5, f2 = .8, f3 = .8)
# Pipe operator can be used if desired
p2 <- set_sem_layout(p,
  indicator_order = indicator_order,
  indicator_factor = indicator_factor,
  factor_layout = factor_layout,
  factor_point_to = factor_point_to,
  indicator_push = indicator_push,
  indicator_spread = indicator_spread,
  loading_position = loading_position)
p2 <- set_curve(p2, c("f2 ~ f1" = -1,
  "f4 ~ f1" = 1.5))
p2 <- mark_sig(p2, fit_sem)
p2 <- mark_se(p2, fit_sem, sep = "\n")
plot(p2)

# Use a named vector for indicator_order
indicator_order2 <- c(f2 = "x04", f2 = "x05", f2 = "x06", f2 = "x07",
  f1 = "x01", f1 = "x02", f1 = "x03",
  f4 = "x11", f4 = "x12", f4 = "x13", f4 = "x14",

```

```

      f3 = "x08", f3 = "x09", f3 = "x10")
p2 <- set_sem_layout(p,
  indicator_order = indicator_order2,
  factor_layout = factor_layout,
  factor_point_to = factor_point_to,
  indicator_push = indicator_push,
  indicator_spread = indicator_spread,
  loading_position = loading_position)

plot(p2)

# Use automatically generated indicator_order and indicator_factor
p2 <- set_sem_layout(p,
  factor_layout = factor_layout,
  factor_point_to = factor_point_to,
  indicator_push = indicator_push,
  indicator_spread = indicator_spread,
  loading_position = loading_position)

plot(p2)

# Use named character vector for factor_point_to
directions <- c(f1 = "left",
  f2 = "left",
  f3 = "down",
  f4 = "down")
p2v2 <- set_sem_layout(p,
  indicator_order = indicator_order,
  indicator_factor = indicator_factor,
  factor_layout = factor_layout,
  factor_point_to = directions,
  indicator_push = indicator_push,
  indicator_spread = indicator_spread,
  loading_position = loading_position)
p2v2 <- set_curve(p2v2, c("f2 ~ f1" = -1,
  "f4 ~ f1" = 1.5))
p2v2 <- mark_sig(p2v2, fit_sem)
p2v2 <- mark_se(p2v2, fit_sem, sep = "\n")
plot(p2v2)

#Lists of named list which are equivalent to the vectors above:
#indicator_push <- list(list(node = "f3", push = 2),
#  list(node = "f4", push = 1.5))
#indicator_spread <- list(list(node = "f1", spread = 2),
#  list(node = "f2", spread = 2))
#loading_position <- list(list(node = "f1", position = .5),
#  list(node = "f2", position = .8),
#  list(node = "f3", position = .8))

```

Description

Convert a named vector to a list of lists, to be used by various functions in [semptools](#).

Usage

```
to_list_of_lists(input, name1 = NULL, name2 = NULL, name3 = NULL)
```

Arguments

input	A named vector
name1	The name for the first element in the list-in-list. Default is NULL.
name2	The name for the second element in the list-in-list. Default is NULL.
name3	The name for the third element in the list-in-list. Default is NULL. If this argument is not NULL, the names of the vector elements will be split using lavaan syntax (by calling <code>lavaan::lavParseModelString()</code>), and the right-hand side (rhs) and left-hand side (lhs) of each element will be assigned to name1 and name2, respectively.

Details

This function is not to be used by users, but to be used internally by other functions of [semptools](#).

Value

A list of lists.

Examples

```
x <- c("x1 ~~ x2" = -1, "x4 ~ x1" = 1)
to_list_of_lists(x, name1 = "from", name2 = "to", name3 = "new_curve")
#list(list(from = "x1", to = "x2", new_curve = -1),
#      list(from = "x1", to = "x4", new_curve = 1))

y <- c(x1 = 0, x2 = 180, x3 = 140, x4 = 140)
to_list_of_lists(y, name1 = "node", name2 = "rotate")
#list(list(node = "x1", rotate = 0),
#      list(node = "x2", rotate = 180),
#      list(node = "x3", rotate = 140),
#      list(node = "x4", rotate = 140))
```

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