

semPlot: Unified visualizations of Structural Equation Models

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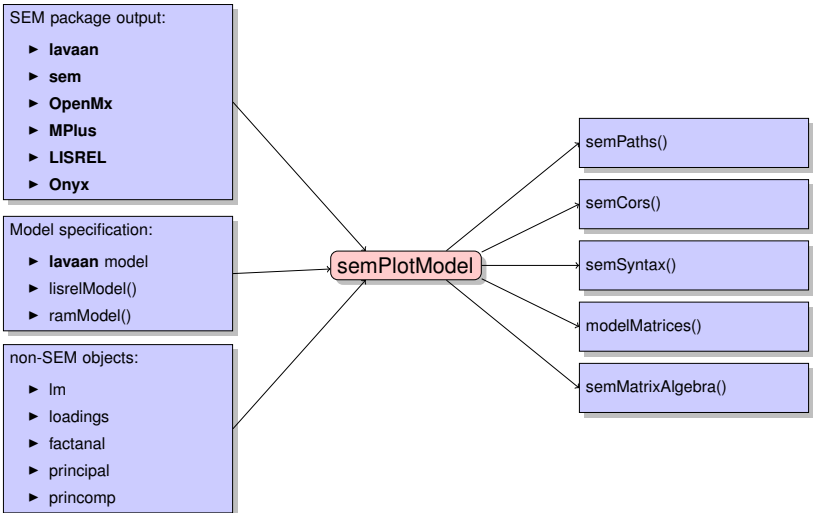
M3 2014
20-05-2014

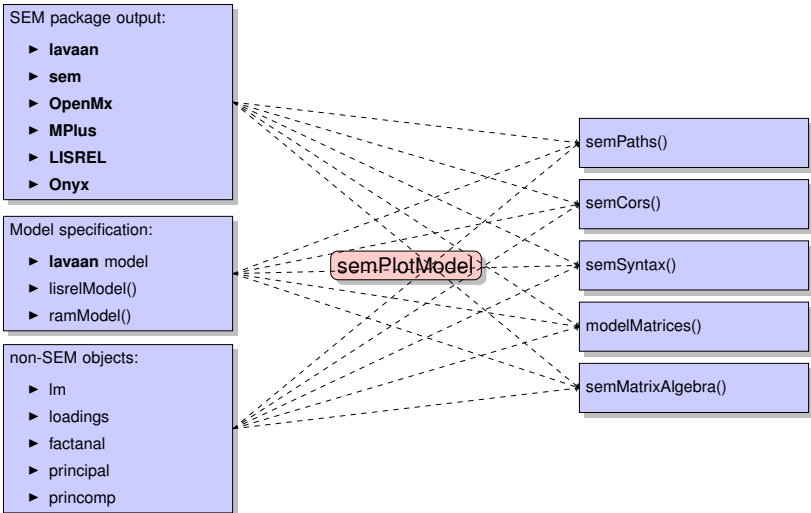
semPlot

- ▶ **R** package dedicated to visualizing structural equation models (SEM)
- ▶ fills the gap between advanced, but time-consuming, graphical software and the limited graphics produced automatically by SEM software
- ▶ Also unifies different SEM software packages and model frameworks in **R**
 - ▶ General framework for extracting parameters from different SEM software packages to different SEM modeling frameworks
- ▶ Sister package and extension to **qgraph** (Epskamp, Cramer, Waldorp, Schmittmann, & Borsboom, 2012)

Supported input

- ▶ **R** (R Core Team, 2013) objects:
 - ▶ `lm`
 - ▶ `loadings`
 - ▶ `factanal`
 - ▶ `princomp`
 - ▶ `principal` (Revelle, 2010)
- ▶ **R** package output:
 - ▶ **lavaan** (Rosseel, 2012)
 - ▶ Output and model
 - ▶ **sem** (Fox, Nie, & Byrnes, 2013)
 - ▶ **OpenMx** (Boker et al., 2011)
 - ▶ Path specification only
- ▶ String indication output file of:
 - ▶ **MPlus** (L. K. Muthén & B. O. Muthén, 1998–2012)
 - ▶ Via **MplusAutomation** (Hallquist & Wiley, 2013)
 - ▶ **LISREL** (Jöreskog & Sörbom, 1996)
 - ▶ Via **lisrelToR** (Epskamp, 2013)



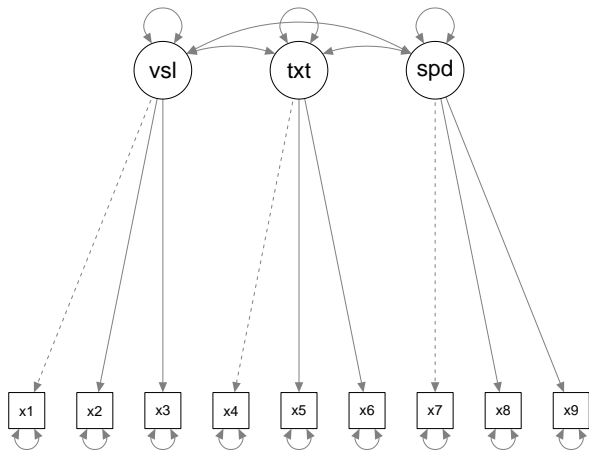


```
library("lavaan")  
## The famous Holzinger and Swineford (1939) example  
HS.model <- ' visual  =~ x1 + x2 + x3  
              textual =~ x4 + x5 + x6  
              speed   =~ x7 + x8 + x9 '  
  
fit <- cfa(HS.model, data=HolzingerSwineford1939)
```

semPaths

`semPaths()` can be used to plot a path diagram:

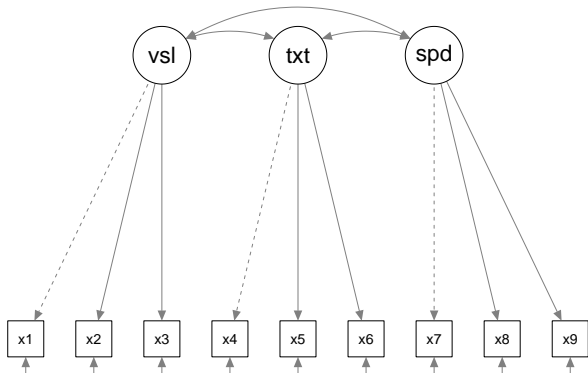
```
semPaths(fit)
```



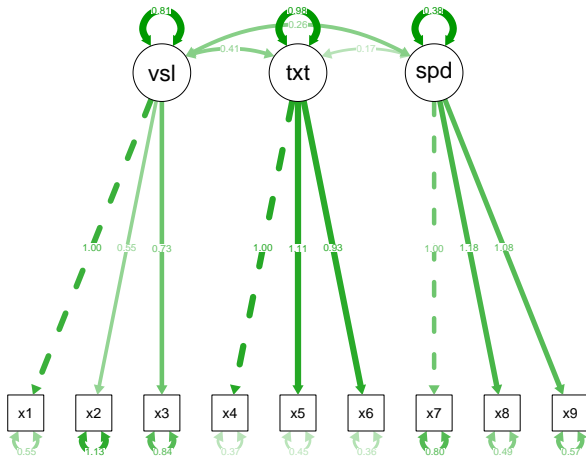
semPaths

`semPaths()` can be used to plot a path diagram:

```
semPaths(fit, style = "lisrel")
```




```
semPaths(fit, "Standardized", "Estimates")
```



semPaths

`semPaths` has quite a lot of arguments:

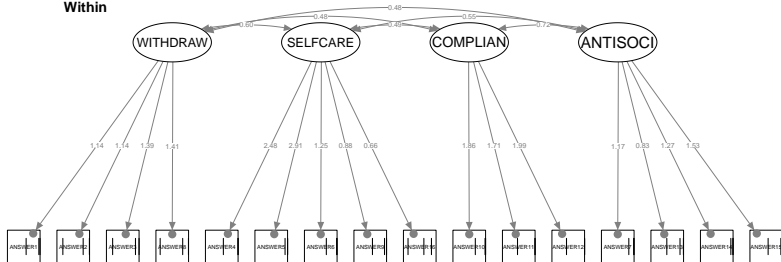
style, layout, intercepts, residuals, thresholds, rotation, curve, curvature, nCharNodes, nCharEdges, sizeMan, sizeLat, sizeInt, sizeMan2, sizeLat2, sizeInt2, shapeMan, shapeLat, shapeInt, ask, mar, title, title.color, title.adj, title.line, title.cex, include, combineGroups, manifests, latents, groups, color, residScale, gui, allVars, edge.color, reorder, structural, ThreshAtSide, thresholdColor, thresholdSize, fixedStyle, freeStyle, as.expression, optimizeLatRes, inheritColor, levels, nodeLabels, edgeLabels, pastel, rainbowStart, intAtSide, springLevels, nDigits, exoVar, exoCov, centerLevels, panelGroups, layoutSplit, measurementLayout, subScale, subScale2, subRes, subLinks, modelOpts, curveAdjacent, edge.label.cex, cardinal, equalizeManifests, covAtResiduals, bifactor, optimPoints

semPaths

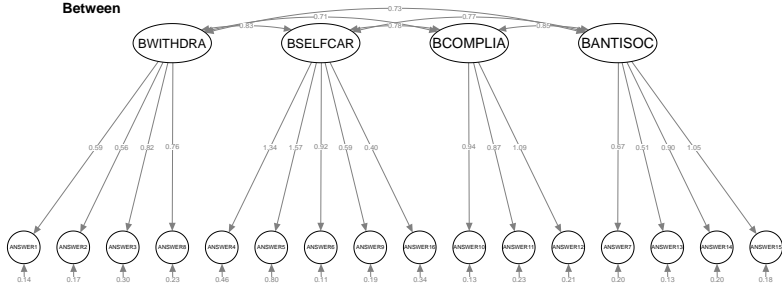
And even more via the `qgraph` backend:

edge.width, node.width, node.height, esize, asize, minimum, maximum, cut, details, mar, filetype, filename, width, height, normalize, DoNotPlot, plot, rescale, label.cex, label.color, borders, border.color, border.width, polygonList, vTrans, label.prop, label.norm, label.scale, label.font, posCol, negCol, unCol, colFactor, trans, fade, loop, curvePivot, curvePivotShape, edge.label.bg, edge.label.position, edge.label.font, layout.par, bg, bgcontrol, bgres, pty, font, arrows, arrowAngle, asize, open, weighted, XKCD, ...

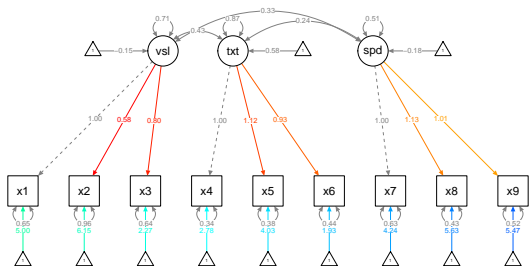
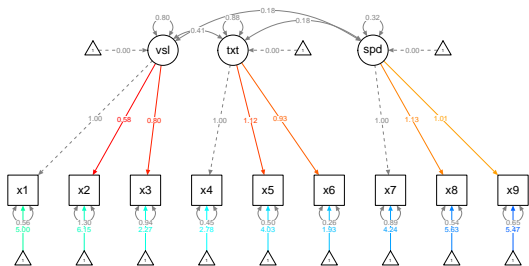
Within



Between



Constraints

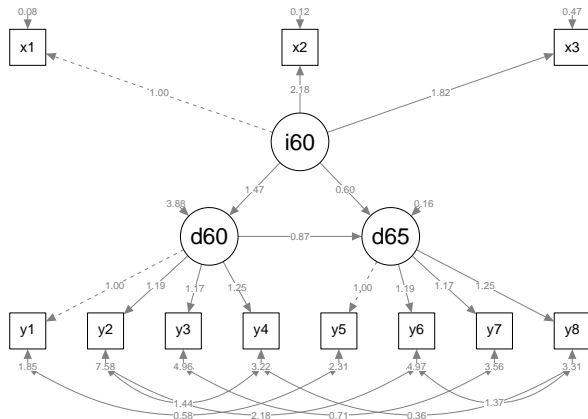


Structural Models

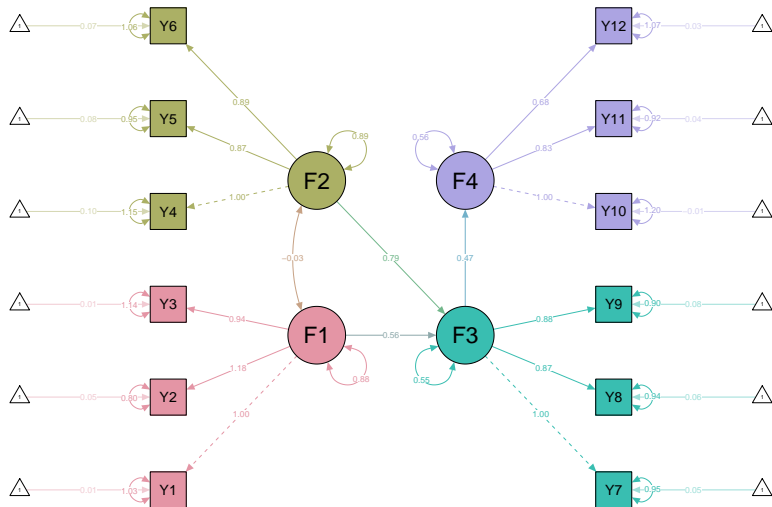
```
# lavaan sem example:
```

```
example(sem)
```

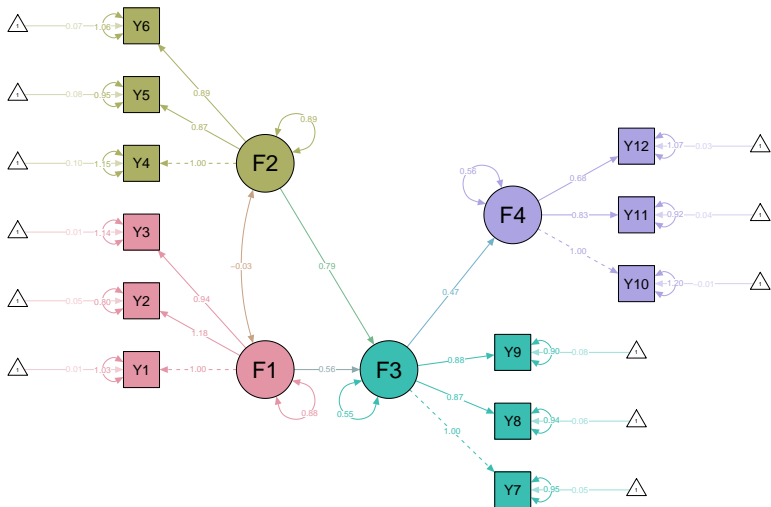
```
semPaths(fit, "model", "est", style = "lisrel")
```



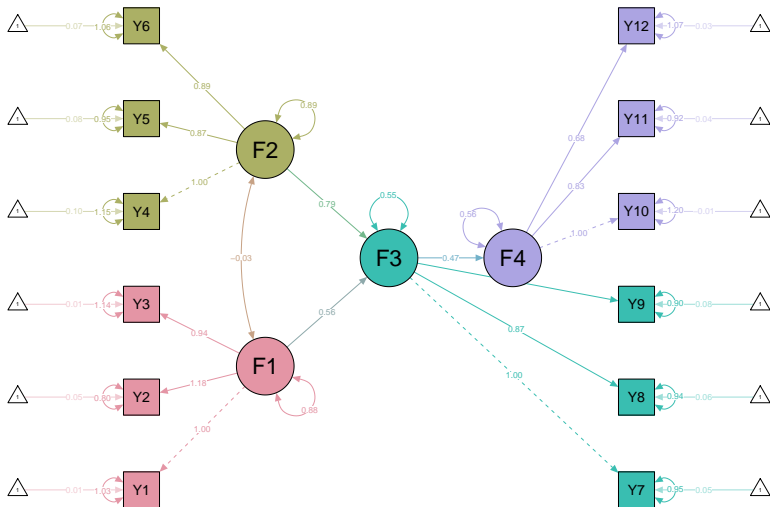
LISREL style layout



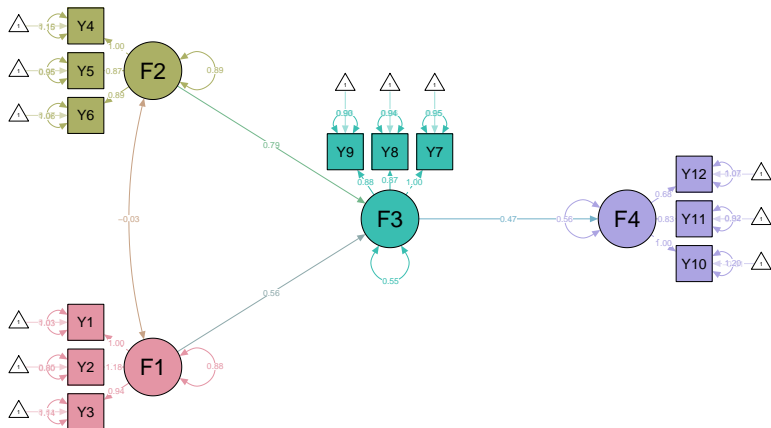
Reingold-Tilford based layout



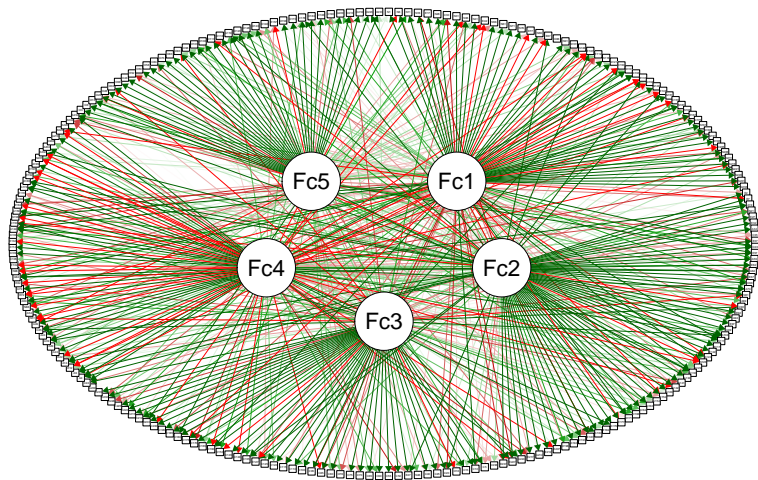
Boker-McArdle-Neale based layout



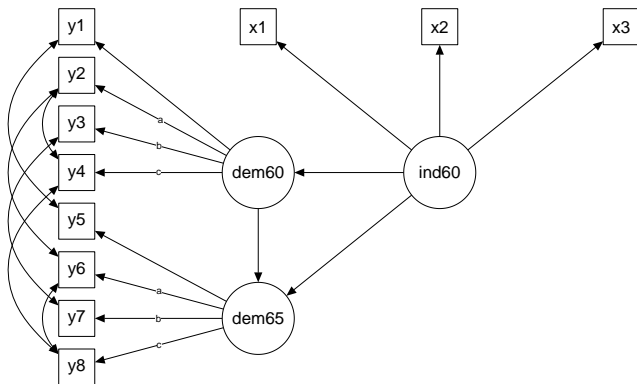
Split measurement and structural models



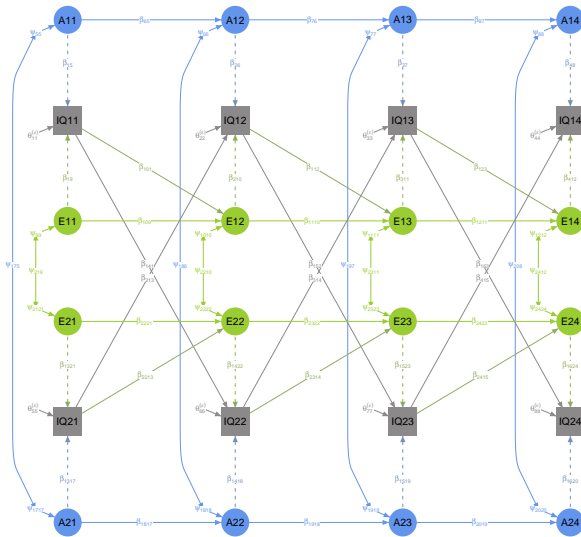
Circular layout



Manual Specification



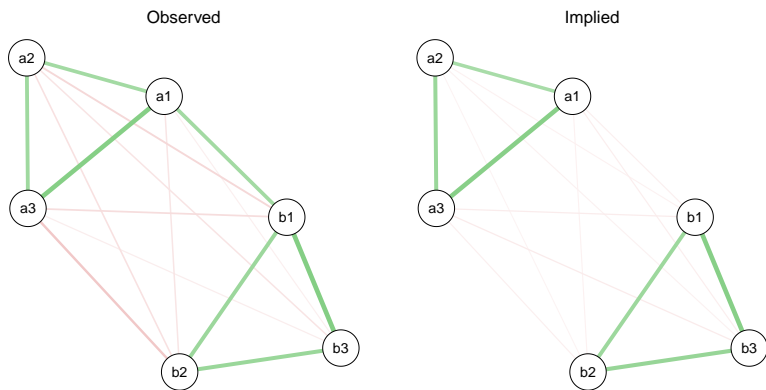
Model by Janneke de Kort

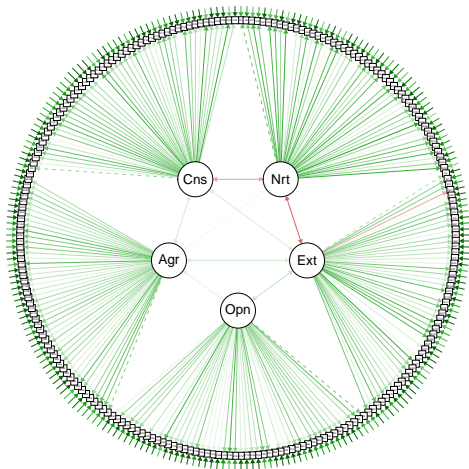


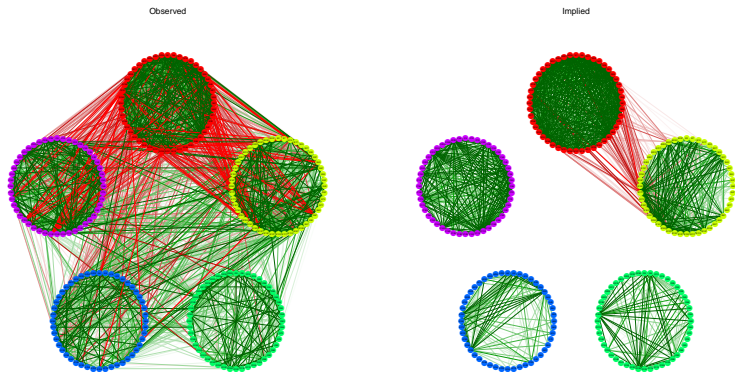
Visual correlation analysis

`semCors()` can be used to plot implied and observed covariances using the **qgraph** framework (Epskamp et al., 2012).

```
semCors(fit, layout = "spring", titles = TRUE)
```







See also See also (Epskamp et al., 2012)

`modelMatrices()` can be used to obtain a list of all matrices in one of three modeling frameworks:

```
names(modelMatrices(fit, "ram"))
```

```
## [1] "A" "S" "F"
```

```
names(modelMatrices(fit, "lisrel"))
```

```
## [1] "LY" "TE" "PS" "BE" "LX" "TD"
```

```
## [7] "PH" "GA" "TY" "TX" "AL" "KA"
```

```
names(modelMatrices(fit, "mplus"))
```

```
## [1] "Nu" "Lambda" "Theta"
```

```
## [4] "Kappa" "Alpha" "Beta"
```

```
## [7] "Gamma" "Psi"
```

The `semMatrixAlgebra()` function makes extracting matrices easier:

```
semMatrixAlgebra(fit, A)

## model set to 'ram'

##      a1 a2 a3 b1 b2 b3      A      B
## a1  0  0  0  0  0  0  1.0000  0.000
## a2  0  0  0  0  0  0  0.7335  0.000
## a3  0  0  0  0  0  0  1.0390  0.000
## b1  0  0  0  0  0  0  0.0000  1.000
## b2  0  0  0  0  0  0  0.0000  0.765
## b3  0  0  0  0  0  0  0.0000  1.012
## A   0  0  0  0  0  0  0.0000  0.000
## B   0  0  0  0  0  0  0.0000  0.000
```

Note how using the term `A` caused the function to automatically identify we were interested in the RAM model.

`semMatrixAlgebra()` can also be used to easily perform algebraic computations:

```
semMatrixAlgebra(fit, Lambda %**% Psi %**% t(Lambda) + Theta)
```



```
## model set to 'mplus'
```


##		a1	a2	a3	b1	b2	b3
## a1	2.02879	0.60113	0.85151	-0.12520	-0.09578	-0.12674	
## a2	0.60113	1.52291	0.62456	-0.09183	-0.07025	-0.09296	
## a3	0.85151	0.62456	1.63260	-0.13008	-0.09951	-0.13168	
## b1	-0.12520	-0.09183	-0.13008	1.95964	0.66839	0.88447	
## b2	-0.09578	-0.07025	-0.09951	0.66839	1.53194	0.67661	
## b3	-0.12674	-0.09296	-0.13168	0.88447	0.67661	1.78813	

`semSyntax` can be used to translate any input to `semPlot` into **lavaan** codes. This has two advantages:

- ▶ Easily fit a model based on an output file in **lavaan**
- ▶ Simulate data based on an estimated model using **lavaan's** `simulateData`

Translating **lavaan** syntax to **MPlus** syntax can be attempted using `lavaan::lav2mplus`. **sem** is also supported but a bit bugged at the moment. Mail me for a **lavaan** to **OpenMx** translator.

Translate **MPlus** to **lavaan**:

```
l <- "http://www.statmodel.com/usersguide/chap5/ex5.1.out"  
download.file(l, modfile <- tempfile(fileext = ".out"))  
Model <- semPlotModel(modfile)  
lavMod <- semSyntax(Model)
```

```
## Reading model:  ex5.1.out  
##  
## Model <- '  
## F1 =~ 1*Y1  
## F1 =~ Y2  
## F1 =~ Y3  
## F2 =~ 1*Y4  
## F2 =~ Y5  
## F2 =~ Y6  
## F2 ~~ F1  
## Y1 ~ 1  
## Y2 ~ 1  
## Y3 ~ 1  
## Y4 ~ 1  
## Y5 ~ 1  
## Y6 ~ 1  
## F1 ~~ F1  
## F2 ~~ F2
```

Simulate data:

```
l <- "http://www.statmodel.com/usersguide/chap5/ex5.1.out"  
download.file(l, modfile <- tempfile(fileext = ".out"))  
Model <- semPlotModel(modfile)  
lavMod <- semSyntax(Model, allFixed = TRUE)
```

Simulate data:

```
library("lavaan")  
head(simulateData(lavMod))
```





```
##           Y1           Y2           Y3           Y4           Y5           Y6  
## 1 -0.1812 -0.86023 -0.26249  0.8436  1.3738 -0.2065  
## 2  0.4026 -1.42322 -0.03974  0.6176  0.5889  0.6993  
## 3  1.2055  0.37841  1.44397  0.7376  0.9466 -0.8903  
## 4  2.1490 -0.67511  0.07165  0.1718 -0.4993 -2.1682  
## 5  0.3397 -0.09025 -0.06618 -1.2264  0.0610 -1.2726  
## 6 -1.5069 -0.81482 -1.58714  1.1065 -0.4947  0.2997
```

Future directions






- ▶ (Better) support for:
 - ▶ **Onyx**
 - ▶ **Amos**
 - ▶ **EQS**
 - ▶ **lava**
 - ▶ **xxM**
- ▶ Extension to different models:
 - ▶ LKA
 - ▶ IRT
 - ▶ Bayesian models
- ▶ Equivalent model sampler
- ▶ Partial correlation matrices

Thank you for your attention!




References I

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