Evaluating SEM predictions

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Fit a SEM

```
library("lavaan")
```

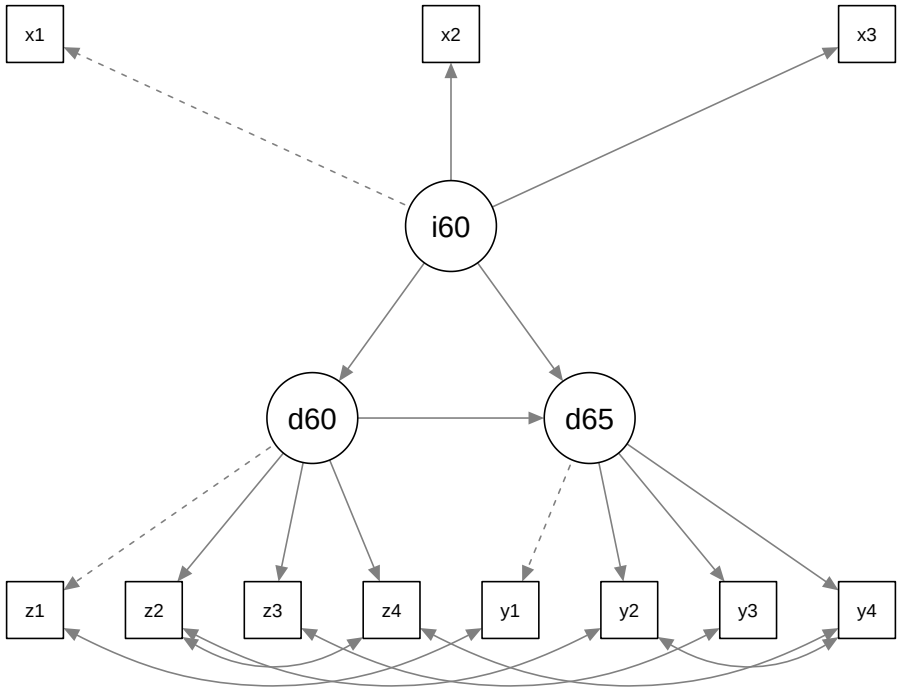
```
## This is lavaan 0.6-15
## lavaan is FREE software! Please report any bugs.
```

```
library("semPlot")
data(PoliticalDemocracy)
head(PoliticalDemocracy)
```

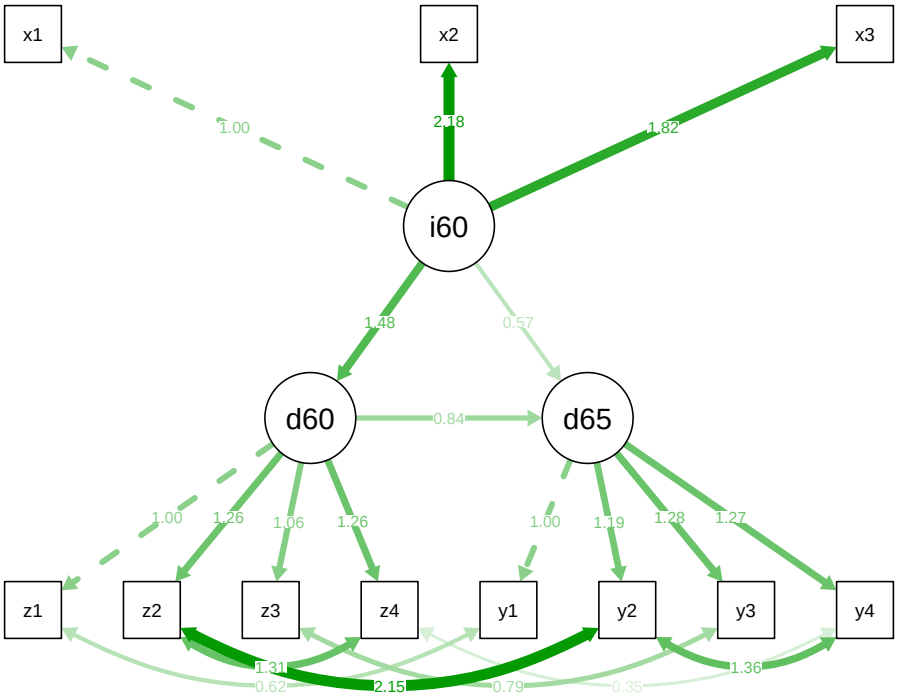
```
##      y1       y2       y3       y4       y5       y6       y7       y8       x1
## 1  2.50 0.000000 3.333333 0.000000 1.250000 0.000000 3.726360 3.333333 4.442651
## 2  1.25 0.000000 3.333333 0.000000 6.250000 1.100000 6.666666 0.736999 5.384495
## 3  7.50 8.800000 9.999998 9.199991 8.750000 8.094061 9.999998 8.211809 5.961005
## 4  8.90 8.800000 9.999998 9.199991 8.907948 8.127979 9.999998 4.615086 6.285998
## 5 10.00 3.333333 9.999998 6.666666 7.500000 3.333333 9.999998 6.666666 5.863631
## 6  7.50 3.333333 6.666666 6.666666 6.250000 1.100000 6.666666 0.368500 5.533389
##         x2       x3
## 1 3.637586 2.557615
## 2 5.062595 3.568079
## 3 6.255750 5.224433
## 4 7.567863 6.267495
## 5 6.818924 4.573679
## 6 5.135798 3.892270
```

```
colnames(PoliticalDemocracy) <- c("z1", "z2", "z3", "z4",
                                  "y1", "y2", "y3", "y4",
                                  "x1", "x2", "x3")
mod <- '

  # latent variable definitions
  ind60 =~ x1 + x2 + x3
  dem60 =~ z1 + z2 + z3 + z4
  dem65 =~ y1 + y2 + y3 + y4

  # regressions
  dem60 ~ ind60
```

```
  dem65 ~ ind60 + dem60

  # residual correlations
  z1 ~~ y1
  z2 ~~ z4 + y2
  z3 ~~ y3
  z4 ~~ y4
  y2 ~~ y4
'
fit <- sem(mod, data = PoliticalDemocracy, meanstructure = TRUE, warn = FALSE)
semPaths(fit, title = FALSE, intercepts = FALSE, residuals = FALSE)
```




```
semPaths(fit, what = "est", intercepts = FALSE, residuals = FALSE)
```



Compute predicted values

```
xnames <- colnames(PoliticalDemocracy)[-c(5, 6, 7, 8)]
ynames <- colnames(PoliticalDemocracy)[c(5, 6, 7, 8)]
lavPredictY(fit, xnames = xnames, ynames = ynames,
            newdata = PoliticalDemocracy[1:10, ])
```

```
##          y1     y2     y3    y4
##  [1,] 2.414 -0.302  2.734 0.565
##  [2,] 2.253 -0.046  2.989 0.807
##  [3,] 7.584  6.324  9.694 7.547
##  [4,] 8.642  7.126 10.608 8.475
##  [5,] 8.428  4.943  9.698 7.362
##  [6,] 6.535  3.448  7.445 5.594
##  [7,] 6.466  3.363  7.352 5.501
##  [8,] 6.059  3.084  7.148 4.156
##  [9,] 3.456  1.733  4.364 2.552
## [10,] 8.494  5.879  9.942 7.824
```

Evaluate predictive accuracy using 10-fold cross validation

```
k <- 10
fold_id <- rep(1:k, length.out = nrow(PoliticalDemocracy))
pred_y <- matrix(0, nrow = nrow(PoliticalDemocracy), ncol = 4)
for (i in 1:k) {

  ## Fit SEM on training data
  fit <- sem(mod, data = PoliticalDemocracy[fold_id != i, ],
             meanstructure = TRUE, warn = FALSE)

  ## Predict on test data
  pred_y[fold_id == i, ] <- lavPredictY(fit, xnames = xnames, ynames = ynames,
                                        newdata = PoliticalDemocracy[fold_id == i, ])

}
```

```
## Warning in lav_object_post_check(object): lavaan WARNING: some estimated lv
## variances are negative
```

```
## Evaluate performance pooled RMSE
sqrt(colMeans((PoliticalDemocracy[ , ynames] - pred_y)^2))
```

```
##       y1       y2       y3       y4
## 1.616693 2.237663 2.223714 2.190521
```