Answers to Exercises Basic CFA

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

Additional Exercise 1

```
wisc4.cor <- lav_matrix_lower2full(c(1.0,
                                     .72, 1.0,
                                     .64, .63, 1.0,
                                     .51, .48, .37, 1.0,
                                     .37, .38, .38, .38, 1))
colnames(wisc4.cor) <- rownames(wisc4.cor) <- c("Information", "Similarities",
                                                "Word.Reasoning", "Matrix.Reasoning",
                                                "Picture.Concepts")
wisc4.sd <- c(3.01, 3.03, 2.99, 2.89, 2.98)
names(wisc4.sd) <- colnames(wisc4.cor)
wisc4.cov <- cor2cov(wisc4.cor, wisc4.sd)
wisc4.model <- '
  g =~ Information + Similarities + Word.Reasoning + Matrix.Reasoning +
  Picture.Concepts
'
wisc4.fit <- cfa(wisc4.model, sample.cov = wisc4.cov, sample.nobs = 550)
```

```
pars <- inspect(wisc4.fit, "est")
pars$beta
```

```
## NULL
```

```
pars$lambda
```

```
##                       g
## Information       1.000
## Similarities      0.985
## Word.Reasoning    0.860
## Matrix.Reasoning  0.647
## Picture.Concepts  0.542
```

```
pars$psi
```

```
##   g
## g 6.648
```

```
pars$theta
```

```
##                  Infrmt Smlrts Wrd.Rs Mtrx.R Pctr.C
## Information      2.395
## Similarities     0.000  2.709
## Word.Reasoning   0.000  0.000  4.009
## Matrix.Reasoning 0.000  0.000  0.000  5.551
## Picture.Concepts 0.000  0.000  0.000  0.000  6.909
```

a) For the standardized-latent-variable identification approach, the matrices will have the same dimensions (i.e., same number of rows and columns) as with the marker-variable approach. Matrices Λ and Ψ will look different: With the marker variable approach, the first element of Λ has a value of one, and the first element of Ψ will be a positive value that is freely estimated. With the standardized-latent-variable approach, the first element of Λ may have a positive or negative value, which is freely estimated; the first element of Ψ will be 1. Matrix Θ will look exactly the same; matrix β will be exactly the same in this example (but this is not necesarily the case).

```
wisc4.fit.std1 <- cfa(wisc4.model, sample.cov = wisc4.cov, sample.nobs = 550,
                      std.lv = TRUE)
pars <- inspect(wisc4.fit.std1, "est")
pars$beta
```

```
## NULL
```

```
pars$lambda
```

```
##                       g
## Information      2.578
## Similarities     2.541
## Word.Reasoning   2.217
## Matrix.Reasoning 1.669
## Picture.Concepts 1.398
```

```
pars$psi
```

```
##   g
## g 1
```

```
pars$theta
```

```
##                  Infrmt Smlrts Wrd.Rs Mtrx.R Pctr.C
## Information      2.395
## Similarities     0.000  2.709
## Word.Reasoning   0.000  0.000  4.009
## Matrix.Reasoning 0.000  0.000  0.000  5.551
## Picture.Concepts 0.000  0.000  0.000  0.000  6.909
```

b)

```
wisc4.model2 <- '
  V =~ Information + Similarities + Word.Reasoning
  F =~ Matrix.Reasoning + Picture.Concepts
'
wisc4.fit.2 <- cfa(wisc4.model2, sample.cov = wisc4.cov,
                   sample.nobs = 550)
pars <- inspect(wisc4.fit.2, "est")
pars$beta
```

```
## NULL
```

```
pars$lambda
```

```
##                       V     F
## Information      1.000 0.000
## Similarities     0.984 0.000
## Word.Reasoning   0.858 0.000
## Matrix.Reasoning 0.000 1.000
## Picture.Concepts 0.000 0.825
```

```
pars$psi
```

```
##   V     F
## V 6.692
## F 4.233 3.957
```

```
pars$theta
```

```
##                  Infrmt Smlrts Wrd.Rs Mtrx.R Pctr.C
## Information      2.352
## Similarities     0.000  2.685
## Word.Reasoning   0.000  0.000  4.000
## Matrix.Reasoning 0.000  0.000  0.000  4.380
## Picture.Concepts 0.000  0.000  0.000  0.000  6.168
```

```
wisc4.model3 <- '
  V =~ Information + Similarities + Word.Reasoning
  F =~ Matrix.Reasoning + Picture.Concepts
  V ~ F
'
wisc4.fit.3 <- cfa(wisc4.model3, sample.cov = wisc4.cov, sample.nobs = 550)
pars <- inspect(wisc4.fit.3, "est")
pars$beta
```

```
##   V    F
## V 0 1.07
## F 0 0.00
```

```
pars$lambda
```

```
##                      V     F
## Information      1.000 0.000
## Similarities     0.984 0.000
## Word.Reasoning   0.858 0.000
## Matrix.Reasoning 0.000 1.000
## Picture.Concepts 0.000 0.825
```

```
pars$psi
```

```
##   V     F
## V 2.164
## F 0.000 3.957
```

```
pars$theta
```

```
##                  Infrmt Smlrts Wrd.Rs Mtrx.R Pctr.C
## Information      2.352
## Similarities     0.000  2.685
## Word.Reasoning   0.000  0.000  4.000
## Matrix.Reasoning 0.000  0.000  0.000  4.380
## Picture.Concepts 0.000  0.000  0.000  0.000  6.168
```

```
wisc4.model4 <- '
  g =~ Information + Similarities + Word.Reasoning + Matrix.Reasoning +
       Picture.Concepts
  Matrix.Reasoning ~~ Picture.Concepts
'
wisc4.fit.4 <- cfa(wisc4.model4, sample.cov = wisc4.cov,
```

```
                   sample.nobs = 550)
pars <- inspect(wisc4.fit.4, "est")
pars$beta
```

```
## NULL
```

```
pars$lambda
```

```
##                      g
## Information      1.000
## Similarities     0.984
## Word.Reasoning   0.858
## Matrix.Reasoning 0.633
## Picture.Concepts 0.522
```

```
pars$psi
```

```
##   g
## g 6.692
```

```
pars$theta
```

```
##                  Infrmt Smlrts Wrd.Rs Mtrx.R Pctr.C
## Information      2.352
## Similarities     0.000  2.685
## Word.Reasoning   0.000  0.000  4.000
## Matrix.Reasoning 0.000  0.000  0.000  5.659
## Picture.Concepts 0.000  0.000  0.000  1.056  7.040
```