Confirmatory Factor Analysis (CFA) - School Trouble Example

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Outline

1. One more quick EFA: change rotation method (override the default)
2. Specify a confirmatory factor analysis (CFA)
3. Generate a path diagram of your CFA model

Getting started - following the routine…

1. Create an R-Project
2. Install packages
3. Load packages

R-Project instructions:

1. click "NEW PROJECT" (upper right corner of window)
2. choose option "NEW DIRECTORY"
3. choose location of project (on desktop OR in a designated folder)

Within R-studio under the files pane (bottom right):

1. click "New Folder" and name folder "data"
2. click "New Folder" and name folder "efa_mplus"
3. click "New Folder" and name folder "cfa_mplus"

DATA SOURCE: This lab exercise utilizes the NCES public-use dataset: Education Longitudinal Study of 2002 (Lauff & Ingels, 2014) See website: nces.ed.gov

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Begin

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loading packages…

```
library(tidyverse)
library(MplusAutomation)
library(here)
library(semPlot)
library(stargazer)
```

read in data

```
trouble_data <- read_csv("https://garberadamc.github.io/project-site/data/els_sub3_school_trouble.csv")
```

take a look at the EFA data (same indicators used for lab 4)

```
stargazer(as.data.frame(trouble_data), type="text", digits=1)
```

```
##
## =====================================================
## Statistic  N  Mean St. Dev. Min Pctl(25) Pctl(75) Max
## -----------------------------------------------------
## BYS22A    718 1.5    0.6    1.0   1.0      2.0    3.0
## BYS22B    717 1.3    0.6    1.0   1.0      1.0    3.0
## BYS22C    714 1.3    0.6    1.0   1.0      1.0    3.0
## BYS22D    715 1.2    0.4    1.0   1.0      1.0    3.0
## BYS22E    711 1.3    0.6    1.0   1.0      1.0    3.0
## BYS22F    716 1.0    0.2    1.0   1.0      1.0    3.0
## BYS22G    716 1.2    0.4    1.0   1.0      1.0    3.0
## BYS22H    713 1.3    0.6    1.0   1.0      1.0    3.0
## BYS24A    719 2.3    1.2    1.0   1.0      3.0    5.0
## BYS24B    715 1.5    0.9    1.0   1.0      2.0    5.0
## BYS24C    712 2.6    1.1    1.0   2.0      3.0    5.0
## BYS24D    711 1.7    0.9    1.0   1.0      2.0    5.0
## BYS24E    719 1.2    0.6    1.0   1.0      1.0    5.0
## BYS24F    713 1.1    0.4    1.0   1.0      1.0    5.0
## BYS24G    719 1.0    0.2    1.0   1.0      1.0    5.0
## -----------------------------------------------------
```

replicate the SAME random split as last week (do not change the seed)

- get the size of half of original sample
- `floor()` helps with rounding

```
smp_size <- floor(0.50 * nrow(trouble_data))
```

set the seed to make partition reproducible

```
set.seed(20210530)
```

`sample()` randomly selects rows of size = "smp_size"

```
calibrate_smp <- sample(seq_len(nrow(trouble_data)), size = smp_size)
```

create two samples called "calibrate" & "validate"

```
calibrate <- trouble_data[calibrate_smp, ]
validate <- trouble_data[-calibrate_smp, ]
```

reorder variables & remove column number 15

```
# removed BYS24G (due to low loading < .2)
calibrate <-  calibrate %>%
  select(1,3:14,2)

# do the same for the validate sample
validate <-  validate %>%
  select(1,3:14,2)
```

Default rotation: Geomin Oblique

run an EFA with the "calibrate" sample

```
efa_geomin  <- mplusObject(
  TITLE = "Geomin Oblique EFA - LAB 5 DEMO",
  VARIABLE =
   "! removed BYS24G (due to low loading < .2)
    usevar = BYS22A-BYS22B;",

  ANALYSIS =
   "type = efa 1 3;
    estimator = mlr;
    rotation = geomin; ! this is the default (added to be explicit)
    parallel=50; ! run parallel analysis",

  MODEL = "" ,

  PLOT = "type = plot3;",
  OUTPUT = "sampstat;",

  usevariables = colnames(calibrate),
  rdata = calibrate)

efa_geomin_fit <- mplusModeler(efa_geomin,
                  dataout=here("05-cfa", "efa_mplus", "efa_geomin_oblique.dat"),
                  modelout=here("05-cfa", "efa_mplus", "efa_geomin_oblique.inp"),
                  check=TRUE, run = TRUE, hashfilename = FALSE)
```

Rotation: Varimax Orthogonal

```
efa_varimax  <- mplusObject(
  TITLE = "Varimax Orthogonal EFA - LAB 5 DEMO",
  VARIABLE =
    " ! removed BYS24G (due to low loading < .2)
    usevar = BYS22A-BYS22B;",

  ANALYSIS =
    "type = efa 1 3;
     estimator = mlr;
     rotation = varimax; ! orthogonal (no factor correlations)
     parallel=50; ! run parallel analysis",

  MODEL = "" ,

  PLOT = "type = plot3;",
  OUTPUT = "sampstat;",

  usevariables = colnames(calibrate),
  rdata = calibrate)

efa_varimax_fit <- mplusModeler(efa_varimax,
                            dataout=here("05-cfa", "efa_mplus", "efa_varimax_orthogonal.dat"),
                            modelout=here("05-cfa", "efa_mplus", "efa_varimax_orthogonal.inp"),
                            check=TRUE, run = TRUE, hashfilename = FALSE)
```

Estimate a Confirmatory Factor Analysis (CFA) model

```
cfa_validate  <- mplusObject(

  TITLE = "CFA Validate",

  VARIABLE =
    "usevar = BYS22A-BYS22B;",

  ANALYSIS =
    "estimator = mlr;",

  MODEL =
    "FACTOR_1 by BYS22A BYS22C BYS22D BYS22E BYS22F BYS22G BYS22H;

     FACTOR_2 BY BYS24A BYS24B BYS24C BYS24D BYS24E BYS24F BYS22B;" ,

  PLOT = "type = plot3;",

  OUTPUT = "sampstat standardized residual modindices (3.84);",

  usevariables = colnames(validate),
  rdata = validate)
```

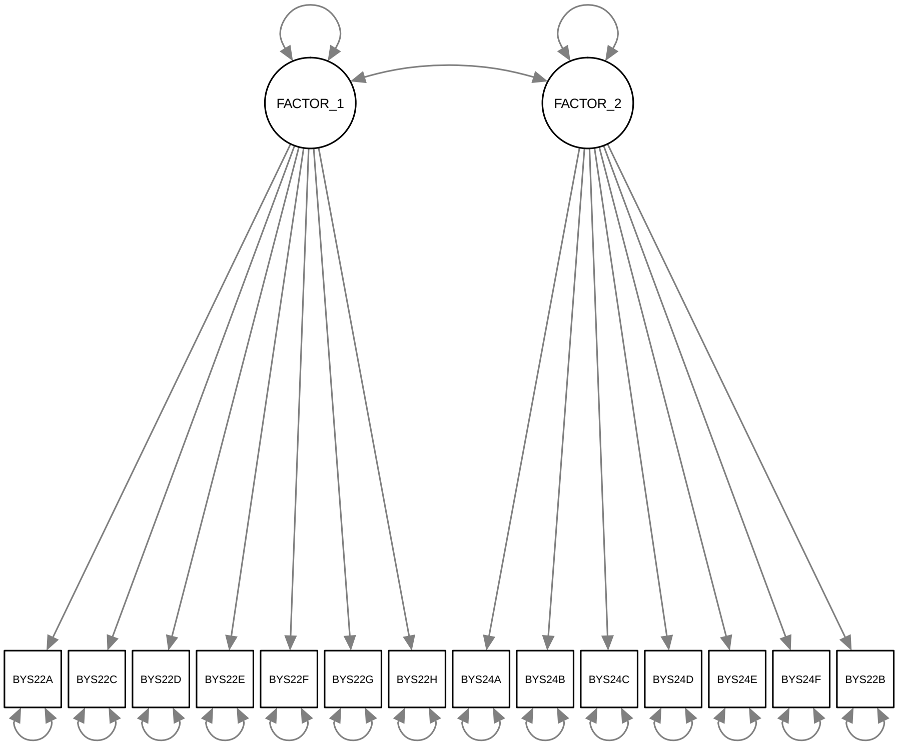
```
cfa_val_fit <- mplusModeler(cfa_validate,
                            dataout=here("05-cfa", "cfa_mplus", "lab5_cfa_validate.dat"),
                            modelout=here("05-cfa", "cfa_mplus", "lab5_cfa_validate.inp"),
                            check=TRUE, run = TRUE, hashfilename = FALSE)
```

create a path diagram of the CFA model Read in the model to R within the `cfa_mplus` folder

```
cfa_output <- readModels(here("05-cfa", "cfa_mplus"), quiet = TRUE)
```

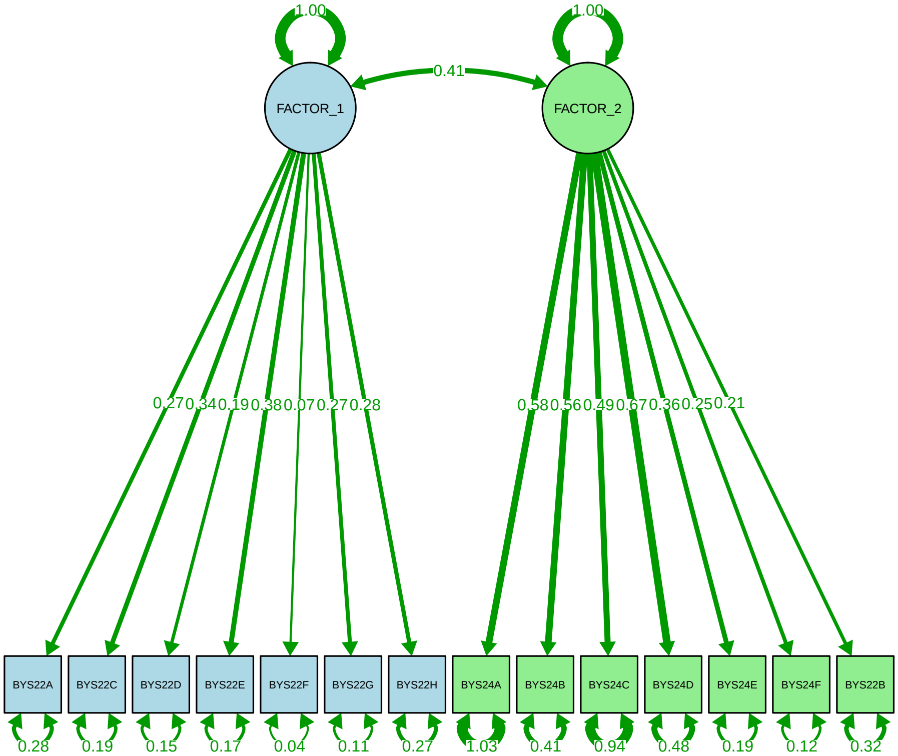
Plot model

```
semPaths(cfa_output,
         intercepts=FALSE,
         fixedStyle = c(1)
         )
```



play with some formatting

```
semPaths(cfa_output, "std",
         intercepts=FALSE,
         fixedStyle = c(1),
         fade = FALSE,
         color= list(lat = c("light blue"," light green")),
        )
```



End

References

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