

# Assignment 3

SEM 1: Confirmatory Factor Analysis

Please hand in a .pdf file containing your report and the .csv file that has been generated. The deadline of this assignment is Tuesday April 23 13:00.

## Multi-group CFA

Suppose I wish to estimate the following model for group 1:

$$\Lambda_1 = \begin{bmatrix} \lambda_{111} & 0 \\ \lambda_{211} & 0 \\ \lambda_{311} & 0 \\ 0 & \lambda_{421} \\ 0 & \lambda_{521} \\ 0 & \lambda_{621} \end{bmatrix}, \Psi_1 = \begin{bmatrix} 1 & \\ \psi_{211} & 1 \end{bmatrix}, \tau_1 = \begin{bmatrix} \tau_{11} \\ \tau_{21} \\ \tau_{31} \\ \tau_{41} \\ \tau_{51} \\ \tau_{61} \end{bmatrix}, \alpha_1 = \begin{bmatrix} \alpha_{11} \\ \alpha_{21} \end{bmatrix}$$

$$\Theta_1 = \begin{bmatrix} \theta_{111} & & & & & \\ & \theta_{221} & & & & \\ & & \theta_{331} & & & \\ & & & \theta_{441} & & \\ & & & & \theta_{551} & \\ & & & & & \theta_{661} \end{bmatrix}$$

and for group 2:

$$\Lambda_2 = \begin{bmatrix} \lambda_{112} & 0 \\ \lambda_{212} & 0 \\ \lambda_{312} & 0 \\ \lambda_{412} & \lambda_{422} \\ 0 & \lambda_{522} \\ 0 & \lambda_{622} \end{bmatrix}, \Psi_2 = \begin{bmatrix} 1 & \\ \psi_{212} & 1 \end{bmatrix}, \tau_2 = \begin{bmatrix} \tau_{12} \\ \tau_{22} \\ \tau_{32} \\ \tau_{42} \\ \tau_{52} \\ \tau_{62} \end{bmatrix}, \alpha_2 = \begin{bmatrix} \alpha_{12} \\ \alpha_{22} \end{bmatrix}$$

$$\Theta_2 = \begin{bmatrix} \theta_{112} & & & & & \\ & \theta_{222} & & & & \\ & & \theta_{332} & & & \\ & & & \theta_{442} & & \\ & & & & \theta_{552} & \\ & & & & & \theta_{662} \end{bmatrix}$$

**Question 1 (1 point)** Calculate the degrees of freedom. ■

**Question 2 (1 point)** Is this model identified? Explain your answer. ■

**Question 3 (1 point)** If this model fits (after potentially identifying the model), would that indicate that *configural invariance* holds? ■

## Measurement invariance

In this assignment, you will use the same personal subset of the Generic Conspiracist Beliefs Scale data as you used last week. Download the file `data.csv` from canvas, which I obtained from [https://openpsychometrics.org/\\_rawdata/](https://openpsychometrics.org/_rawdata/). You can load the data in R as follows:

```
FullData <- na.omit(read.csv("data.csv"))
```

Next, run the following code in R (replace ... with your student number, or your birthday (YYYYMMDD) if you do not have a student number):

```
studentNumber <- ...
set.seed(studentNumber)
Data <- FullData[sample(1:nrow(FullData), 500), ]
```

We will make one change to the data and add a group variable indicating if people obtained a university degree (1) or not (0):

```
Data$university <- 1*(Data$education >= 3)
```

Now, write the csv file to your working directory:

```
write.csv(Data,paste0("conspiracyData_a3_",studentNumber, ".csv"), row.names = FALSE)
```

If you work with Onyx, you may instead export the following files with datasets per group:

```
write.csv(Data[Data$university == 0,],
  paste0("conspiracyData_a3_nouni_",studentNumber, ".csv"),
  row.names = FALSE)
write.csv(Data[Data$university == 1,],
  paste0("conspiracyData_a3_uni_",studentNumber, ".csv"),
  row.names = FALSE)
```

If you do not use R, let someone run this code for you and send you the csv file (do use your own student number). As a reminder, this dataset contains your personal  $n = 500$  subset of a larger dataset in which the Generic Conspiracist Beliefs Scale (Brotherton, French, & Pickering, 2013) was administered. This scale aims to measure “government malfeasance” (GM), “extraterrestrial cover-up” (ET), “malevolent global conspiracies” (MG), “personal wellbeing” (PW), and “control of information” (CI).

The aim of this assignment is to investigate if higher educated people differ in their conspiracy beliefs. Normally if, e.g., weak invariance does not hold, we would not test further levels of measurement invariance. For the purpose of exercising, however, you may continue testing further levels of invariance even if an earlier level does not hold. Note: if you use Jasp, you cannot test for partial invariance and it is sufficient to only state which parameters you would test not constrain equal across groups.

**Question 4 (2 points)** Fit a *configural invariance* model to the data (1 point) and judge if configural invariance holds (1 point). You may use either the original CFA model or your previously adjusted CFA model from assignment. ■

**Question 5 (1 point)** Using the model from Question 4, test if *weak invariance* holds or, if not, if partial weak invariance holds. ■

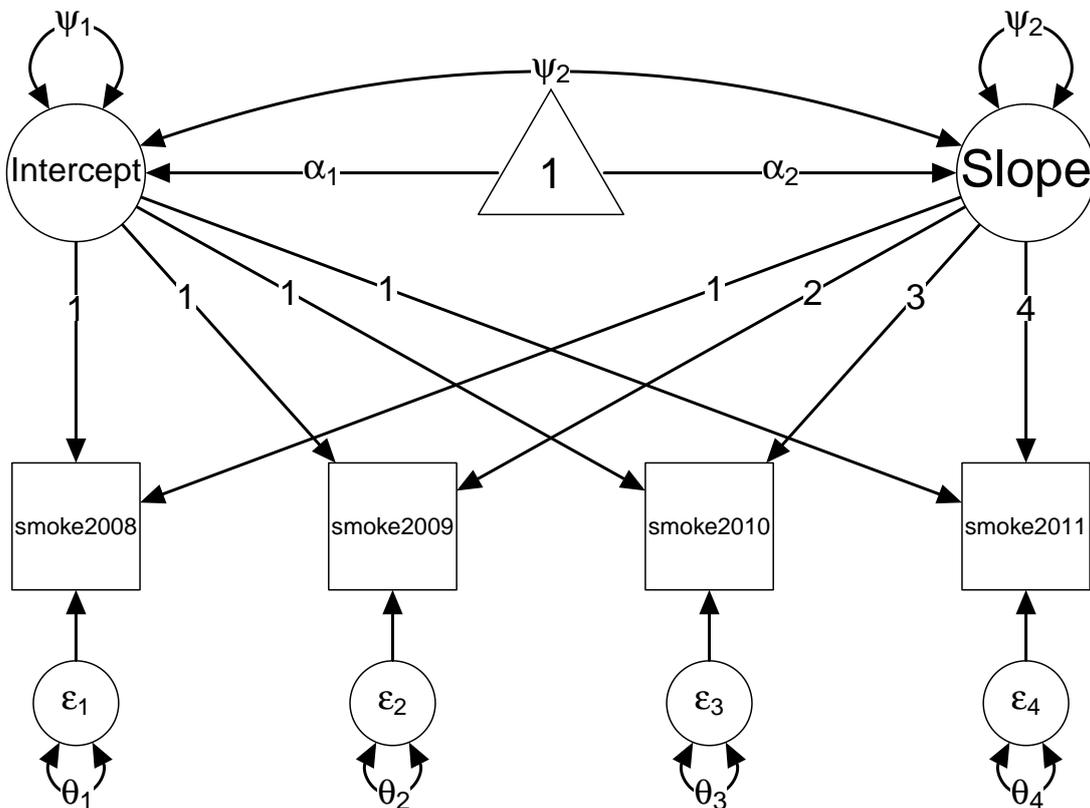
**Question 6 (1 point)** Using the model from Question 5, test if *strong invariance* holds or, if not, if partial strong invariance holds. ■

**Question 7 (1 point)** Using the model from Question 6, test if *strict invariance* holds or, if not, if partial strict invariance holds. ■

**Question 8 (2 points)** Investigate if people with a university degree differ in their variances (1 point) and mean levels (1 point) on the five latent traits, and interpret the results. You may use either the strong or the strict invariance model for this purpose, depending on if you judged strict invariance to hold in Question 7. ■

## Latent growth models

Download the file “smoking.csv” from Canvas and load the data. This is a subset of the LISS panel data on health (<https://www.dataarchive.lissdata.nl>, please do not share the data). The data file contains answers of subjects on the question “How many cigarettes (including rolling tobacco) [did/do] you smoke on average per day?” in the period 2008 to 2011. Only subjects with no missing data are included. We may be interested in the following latent growth curve model:



**Question 9 (2 points)** Fit the model above (1 point) and judge the fit (1 point) ■

**Question 10 (1 point)** Investigate the estimated parameters. Did the subjects, on average, reported an increase or a decrease in the amount they smoked? Did people also differ in this increase or decrease? ■

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## References

- Brotherton, R., French, C. C., & Pickering, A. D. (2013). Measuring belief in conspiracy theories: The generic conspiracist beliefs scale. *Frontiers in psychology, 4*, 279.