Basic LVM course (July 6, 8 & 10, 2020)

Schedule

The course will be taught by Dr. Julian Karch and Dr. Marjolein Fokkema. The schedule is as follows:

- Monday 10.00 - 13.00: Introduction / path models (Dr. Julian Karch)
- Monday 14.00 - 17:00: Basic confirmatory factor analysis (CFA) (Dr. Marjolein Fokkema)
- Wednesday 10.00 - 13.00: Basic latent growth curve models (LGCMs) (Dr. Julian Karch)
- Wednesday 14.00 - 17:00: CFA with binary and ordered-categorical item responses / Item response theory (Dr. Marjolein Fokkema)
- Friday 10.00 - 13.00: Measurement invariance / multiple group analyses (Dr. Marjolein Fokkema)
- Friday 14.00 - 17:00 Miscellaneous (Dr. Marjolein Fokkema)

Content

Latent variable modeling is a vast area of research, this course aims to provide an introduction to the topic. This course will focus on how to fit LVMs to your data and will not go into detail on computational and mathematical aspects. This course provides an introduction, but when you fit these models in your own research, you will also have to have some knowledge about the computational and mathematical aspects. These can be found in external references (see **Literature**). Furthermore, you are encouraged to ask questions about these aspects during the course.

Note that the content of the last session (Friday afternoon) has not been decided yet. The content of this session will be decided on, together with the students, during the course. For example, students may suggest a topic that requires further explanation, request an additional examples of analyses, or put forward datasets and research questions from their own research.

Each session will consist of a plenary lecture, after which students will work on exercises in which they fit and interpret LVMs. While students work on the exercises, the teacher is available for help and further questions.

Location

The course will be taught through Microsoft Teams. For instructions on downloading and signing in to teams, see https://www.staff.universiteitleiden.nl/vr/working-from-home/working-with-teams. All participants have been added to this course's team "Latent Variable Modeling (Summer School 2020)" already. Check if you are indeed part of this team. If not, you should be able to join the team using the following link:

https://teams.microsoft.com/l/team/19%3a3d4c32824f024b4dbcc5d8c9dfb3cb54%40thread.tacv2/conversations?groupId=3776ad84-f9a3-431d-aa16-c1fac75a0a5a&tenantId=ca2a7f76-dbd7-4ec0-9108-6b3d524fb7c8

If you are unable to find or join the team, please send and email to the instructors.

Materials and literature

All course materials are available from an online repository: https://github.com/marjoleinF/LVMbasic.

For the course, we will use the book 'Latent variable modeling using R' by Alexander Beaujean. You can download a digital copy of the book here: https://www-taylorfrancis-com.ezproxy.leidenuniv.nl:

2443/books/9781315869780.

Possibly, you first have to sign in here https://catalogue.leidenuniv.nl/ (click 'Sign in' in the top-right of the page).

Note that this book provides a helpful how-to guide to get started with fitting LVMs in R, but should not be used as a key reference for LVMs. The following books are authorative references in the field of LVMs (more or less ordered by level of difficulty):

- 'Structural Equation Modeling: Foundations and Extensions' by David W. Kaplan
- 'Handbook of Structural Equation Modeling', edited by Rick H. Hoyle
- 'Structural Equations with Latent Variables' by Kenneth A. Bollen

Preparation

Make sure you have installed the latest version of the `lavaan` package in `R`. E.g., by typing:

```
install.packages("lavaan")
```

Check whether you can load the package by typing:

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

To prepare for the course, complete the following assignment:

Assignment

First, we create an artificial dataset containing three random variables: x (a predictor variable), y (a response variable) and m (a variable that 'mediates' the effect of x on y):

```
set.seed(1234)
X <- rnorm(100)
M <- 0.5*X + rnorm(100)
Y <- 0.7*M + rnorm(100)
Data <- data.frame(X = X, Y = Y, M = M)
```

Now, we will fit a regression model to these data. We define the model using `lavaan` synstax:

```
model <- '
  # direct effect
  Y ~ c*X
  # mediator
  M ~ a*X
  Y ~ b*M
  # indirect effect (a*b)
  ab := a*b
'
```

Note that our model comprises a (direct) effect of x on y which is labeled `c`; an effect of x on m which is labeled `a`; an effect of m on y which is labeled `b`. Furthermore, because we want to assess both direct and indirect effects of x on y, we have included and labeled the indirect effect as `ab`. We used octothorpes (`#`) to include comments; these can be left out, but can often be helpful to understand what you did in your analyses later on.

Also note that `model` is just a long character string:

```
class(model)
```

```
## [1] "character"
```

Thus, `lavaan` models are character strings. If there is something wrong with your model specification, in many cases you will not get a warning or error message when you have defined the model, but only when you try to fit it to your data. To fit this model to our dataset, we employ `lavaan`'s `sem()` function:

```
fit <- sem(model, data = Data)
```

To inspect the fitted model, we use the `summary` method (results omitted):

```
summary(fit)
```

Use the output resulting from the code above to answer the following questions:

a) Draw a path diagram (manual or digital), depicting the regression relationships between x, m and y and include the parameter estimates from the fitted model.

b) Is the direct effect of x on y statistically significant at the $\alpha = .05$ level?

c) Is the indirect effect of x on y via m statistically significant at the $\alpha = .05$ level?

d) Specify a simpler model in `lavaan` syntax, which only includes the association between x and y and does not include m. Fit this model to the same dataset and inspect the results. Is the direct effect of x on y statistically significant at the $\alpha = .05$ level?

e) Do your answers to part b) and d) differ? If so, explain why.