Exercises Day 2-1: Stability of Network Modeling

Oldenburg, 12/01/2018

Data-analysis

In R, run the following code:

```
install.packages("psych")
```

```
library("psych")
data("bfi")
bfiData <- bfi[,1:25]
```

The data frame `bfiData` contains the questions of the `bfi` (Big Five Inventory) data contained in the *psych* package. More information on this dataset can be obtained by running:

```
?bfi
```

The questions are designed to measure five central personality traits: Agreeableness, Conscientiousness, Extraversion, Neuroticism, and Opennness. The following table gives the item descriptions:

Item label	Item description	Trait
A1	Am indifferent to the feelings of others	Agreeableness
A2	Inquire about others' well-being	Agreeableness
A3	Know how to comfort others	Agreeableness
A4	Love children	Agreeableness
A5	Make people feel at ease	Agreeableness
C1	Am exacting in my work	Conscientiousness
C2	Continue until everything is perfect	Conscientiousness
C3	Do things according to a plan	Conscientiousness
C4	Do things in a half-way manner	Conscientiousness
C5	Waste my time	Conscientiousness
E1	Don't talk a lot	Extraversion
E2	Find it difficult to approach others	Extraversion
E3	Know how to captivate people	Extraversion
E4	Make friends easily	Extraversion
E5	Take charge	Extraversion
N1	Get angry easily	Neuroticism
N2	Get irritated easily	Neuroticism
N3	Have frequent mood swings	Neuroticism
N4	Often feel blue	Neuroticism
N5	Panic easily	Neuroticism
O1	Am full of ideas	Opennness
O2	Avoid difficult reading material	Opennness
O3	Carry the conversation to a higher level	Opennness
O4	Spend time reflecting on things	Opennness
O5	Will not probe deeply into a subject	Opennness

We can compute a polychoric correlation matrix based on this data as follows:

```
library("qgraph")
corMat <- cor_auto(bfiData)
```

Next we can use *qgraph* to compute a partial correlation network:

```
qgraph(corMat, graph = "pcor", layout = "spring", cut = 0)
```

We can use the *bootnet* function `estimateNetwork` to automate this process:

```
library("bootnet")
Result_pcor <- estimateNetwork(bfiData, default = "pcor")
plot(Result_pcor, layout = "spring", cut = 0)
```
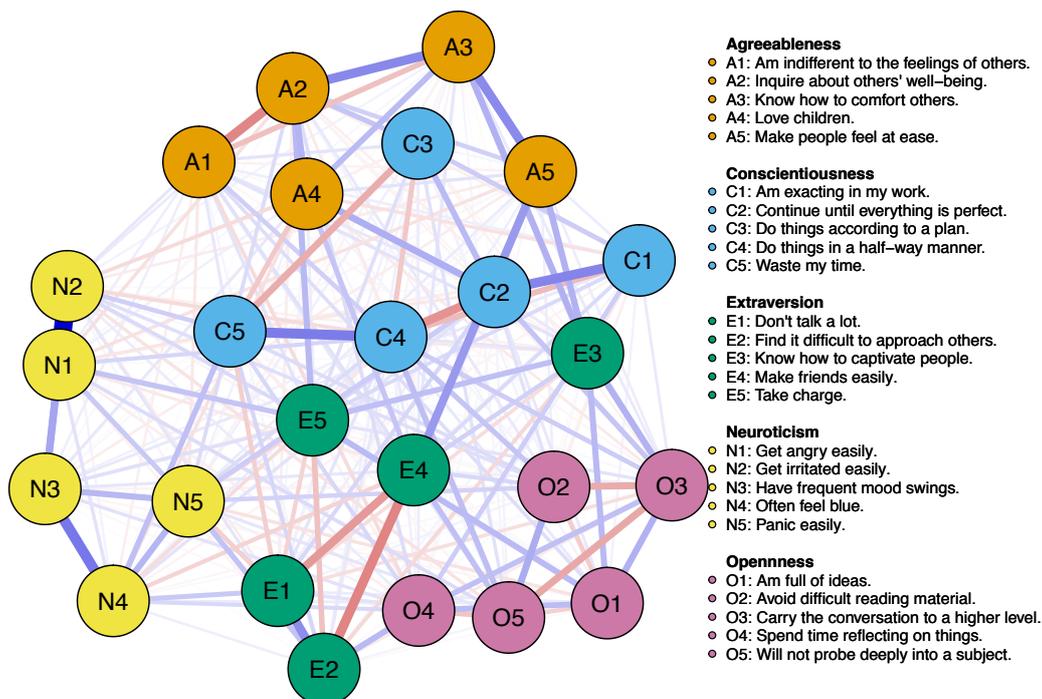
> **Exercise 1** Obtain the weights matrices from qgraph and bootnet by applying the `getWmat` function to output of both. Confirm that the results are identical (tip: the operator == tests if values in R are equal).

We can load for each node the item description and factor the item is aimed to measure as follows:

```
Names <- scan("http://sachaepskamp.com/files/BFIitems.txt",
              what = "character", sep = "\n")
Traits <- rep(c(
  'Agreeableness',
  'Conscientiousness',
  'Extraversion',
  'Neuroticism',
  'Opennness'
),each=5)
```

These can be used to plot a legend next to the graph. In combination, we can make the graph friendly to colorblind viewers using the `theme` option:

```
plot(Result_pcor,
     layout = "spring",
     cut = 0,
     theme = "colorblind",
     groups = Traits,
     nodeNames = Names,
     legend.cex = 0.4)
```


Agreeableness
- A1: Am indifferent to the feelings of others.
- A2: Inquire about others' well–being.
- A3: Know how to comfort others.
- A4: Love children.
- A5: Make people feel at ease.

Conscientiousness
- C1: Am exacting in my work.
- C2: Continue until everything is perfect.
- C3: Do things according to a plan.
- C4: Do things in a half–way manner.
- C5: Waste my time.

Extraversion
- E1: Don't talk a lot.
- E2: Find it difficult to approach others.
- E3: Know how to captivate people.
- E4: Make friends easily.
- E5: Take charge.

Neuroticism
- N1: Get angry easily.
- N2: Get irritated easily.
- N3: Have frequent mood swings.
- N4: Often feel blue.
- N5: Panic easily.

Opennness
- O1: Am full of ideas.
- O2: Avoid difficult reading material.
- O3: Carry the conversation to a higher level.
- O4: Spend time reflecting on things.
- O5: Will not probe deeply into a subject.

In `estimateNetwork`, the `fun` argument can be specified a custum function estimating the network from data. To aid the user, several default functions have been built in. For example, `default = "pcor"` specified a function that estimates a partial correlation networks (in the help file this function is called `bootnet_pcor`).

> **Exercise 2** Use the `default` argument in `estimateNetwork` to estimate a partial correlation network using glasso and EBIC model selection.
> ∎

> **Exercise 3** Perform a *non-parametric* bootstrap on the EBICglasso network and plot the confidence intervals of the edge-weights.
> ∎

> **Exercise 4** Perform a *case-drop* bootstrap on the EBICglasso network and plot the stability of centrality indices.
> ∎

> **Exercise 5** Give the *CS*-coefficient of the three centrality indices, and explain how this measure can be interpreted.
> ∎

SEM re-analysis

Doosje, Loseman, and Bos (2013) analyzed radicalization of Islamic youth in the Netherlands using a large-scale structural equation model (SEM), which can be drawn as a directed causal network:
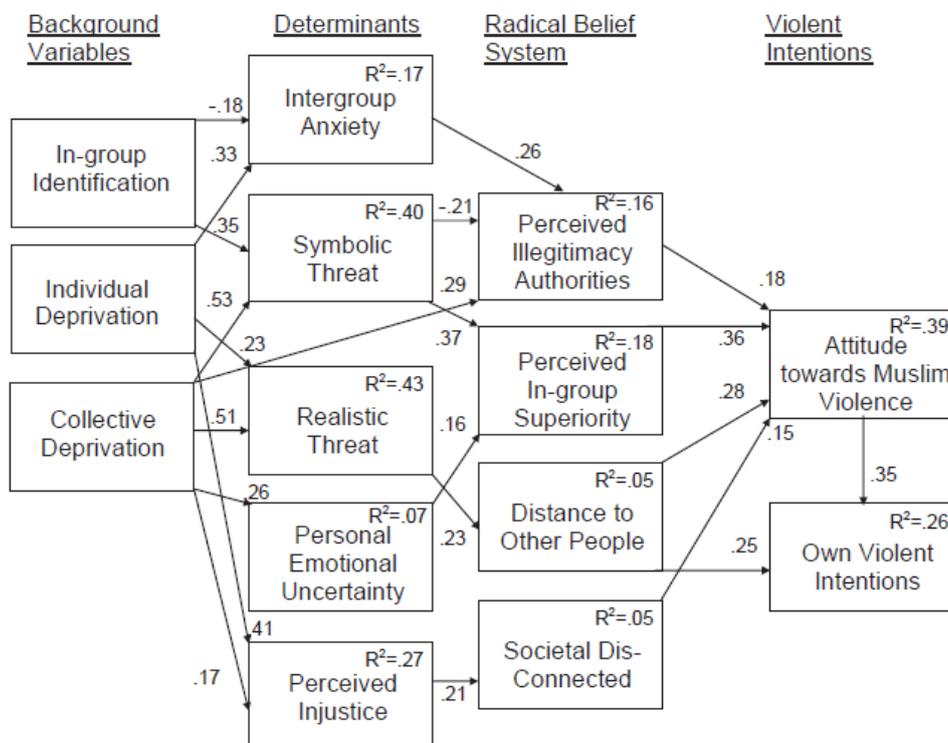

Fig. 1. Final structural equation model. All paths are significant. R^2 = % variance explained.

As with many SEM papers, Doosje et al. (2013) reported the correlation matrix and sample size ($N = 131$) to reproduce their analyses. We can load the correlation matrix in R as follows:

```
source("http://sachaepskamp.com/files/DoosjeData.R")
View(corMat)
```

The `corMat` object now contains the correlation matrix. A SEM analysis as shown above can be used to test a confirmatory model, as is done by Doosje et al. (2013). Suppose however we had no theory and want to exploratory find a good fitting model. SEM is less useful for exploratory model search, as there are many equivalent models possible that fit just as well. For this reason, undirected networks offer a powerfull tool in gaining exploratory insight in which variables might interact.

> **Exercise 6**
>
> Estimate a Gaussian graphical model using LASSO regularization and EBIC model selection on the data from Doosje et al. (2013). Note that you do not have the raw data, so you can not use `estimateNetwork` and need to use the underlying estimation function from the *qgraph* package (`EBICglasso`). Set the EBIC tuning parameter γ to zero. Compare your estimated network to the SEM model reported. Are there edges in your network that are not included in the model shown by Doosje et al. (2013)?
>
> ∎

References

Doosje, B., Loseman, A., & Bos, K. (2013). Determinants of radicalization of islamic youth in the netherlands: Personal uncertainty, perceived injustice, and perceived group threat. *Journal of Social Issues*, *69*(3), 586–604.

Fried, E. I., Bockting, C., Arjadi, R., Borsboom, D., Amshoff, M., Cramer, O. J., . . . Stroebe, M. (2015). From loss to loneliness: The relationship between bereavement and depressive symptoms. *Journal of abnormal psychology*, *124*(2), 256–265.