Tutorial of network analyses of ESM data: the lagnetw package

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Abstract

Network analyses have many applications. In this tutorial we focus on networks build with data obtained with the experience sampling method (ESM). The networks are directed, the relations between the variables in the network are directed because lagged predictors are used. An arrow in the network represents an effect from a variable measured at t-1 on another variable measured at t or on itself measured at t.

In this tutorial we will show how the package “lagnetw” can be used to do a network analysis.

Keywords: network ESM lags Multilevel

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Introduction

For this tutorial a network is defined as a visual representation of a set of variables together with the relations between these variables. The aim of such a network is to better understand the underlying process, which has realized the measurements on the variables. etc. etc. Examples of the network approach in personality research are in (Costantini et al., 2015). Other papers discuss the psychological networks and their accuracy (Epskamp, Borsboom, & Fried, 2018) and controversial issues related to networks for psychopathology (Bringmann & Eronen, 2018).

The `lagnetw` is in the R package `lagnetw`. This package can be installed from Github and then loaded using the `library()` function:

```
devtools::install_github("PeterVerboon/lagnetw")
```

```r
library(lagnetw)
```

ESM

short about what and why of ESM data

Building a Network

There are many ways to construct a network of psychological variables [refs]. For instance, a network can simply build from the correlation matrix using the `qgraph` package [Epstein]. Here, we demonstrate the multilevel regression approach with lagged variables. The general idea is that we estimate for each variable measured at time t, the strengh of the effect of all the other variables on it, where the predictors are measured at time t-1.The effects of a predictor on a given variable, say y(t), is controlled for by all other predictors, including the given variable measured at t-1 (y(t-1)).

$$y_j(t) = b_{j0} + \sum_{k=1}^{M} b_{jk} y_k(t-1) + e_j. \quad (1)$$

where j = 1,..,M and k = 1,..,M. When we have M variables for which we want to build a network, there are also M predictors for each variable. After running the analyses the regression coefficients are gathered in a square matrix. The diagonal of this matrix represents the effects of y(t-1) on y(t), controlled for the other predictors. Since ESM data are hierarchical, the measurements are clustered within days and within subjects. To deal with possible cluster effects of subjects, the regression model shown in formula (1) is extended to a multilevel model.

$$\begin{aligned} y_{ij}(t) &= b_{ij0} + \sum_{k=1}^{M} b_{ijk} y_{ik}(t-1) + e_{ij} \\ b_{ij0} &= b_{j0} + u_{ij0} \\ b_{ijk} &= b_{jk} + u_{ijk}. \end{aligned} \quad (2)$$

Example

The data for this example (DataNews) are obtained in a ESM study about the effect of daily news perception on mood fluctuations. During 10 days, and at 7 random moments per day, participants indicated whether they had perceived news, and if they had, to rate the valence of the news using 5 variables. After that they had to rate their mood using items from the PANAS. After selecting a relevant subset of the data for this example, we construct an object `vars`, which cobtains the variable names that will be used to build the network. To label the vars in the network plot with convenient symbols, we can define labels, which we add in the object `labs`. Furthermore, groups are defined for the variables in the object `newsGroup`. Variables belonging to each other are placed in the same group.

Here we have variables that refer to the news, which indicate the subjective valence of the news (the Valence group), and we have mood items, put in the group called “Affect”.

```
data("DataNews")
 # Select the records where news was perceived
dat <- subset(DataNews, News_YesNO == 1)
vars <- c("Cheerful","Relaxed","Down","Irritated","Insecure","Anxious",
          "Dramatic","Fearful","Hopeful","Inspiring")
labs <- c("CH","REL","DOW", "IRR","INS","ANX","DRA","FF","HO","SPI")
newsGroup <- list(Affect = c(1:6), Valence = c(7:10))
 # select the relevant variables only
dat1 <- dat[,c(vars,c("Participant","daynr","beepnr","Gender2","Age"))]

res <- esmNetwork(dat=dat1,
                  subjnr="Participant",
                  level2 = "daynr",
                  level1 = "beepnr",
                  vars = vars,
                  covs = c("Gender2","Age"),
                  randomAll = FALSE,
                  randomVars =  NULL,   ## c("Fearful","Hopeful"),
                  layout = "spring",
                  lagn = 1,
                  groups = newsGroup,
                  plimit = 0.05,
                  solid = .20,
                  labs = labs)
```

```r
plot(res$output$network)
```

The function 'esmNetwork()' is used to run the analyses and build a network based on these analyses.

Indices of centrality

To better unbderstand the role of the variables in the network several statistics for a network have been developped, which are called indices of centrality.

Note

We used R (Version 3.5.1; R Core Team, 2018) and the R-packages *lagnetw* (Version 0.0.1; Verboon, 2019), and *papaja* (Version 0.1.0.9842; Aust & Barth, 2018) for all our analyses.

References

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