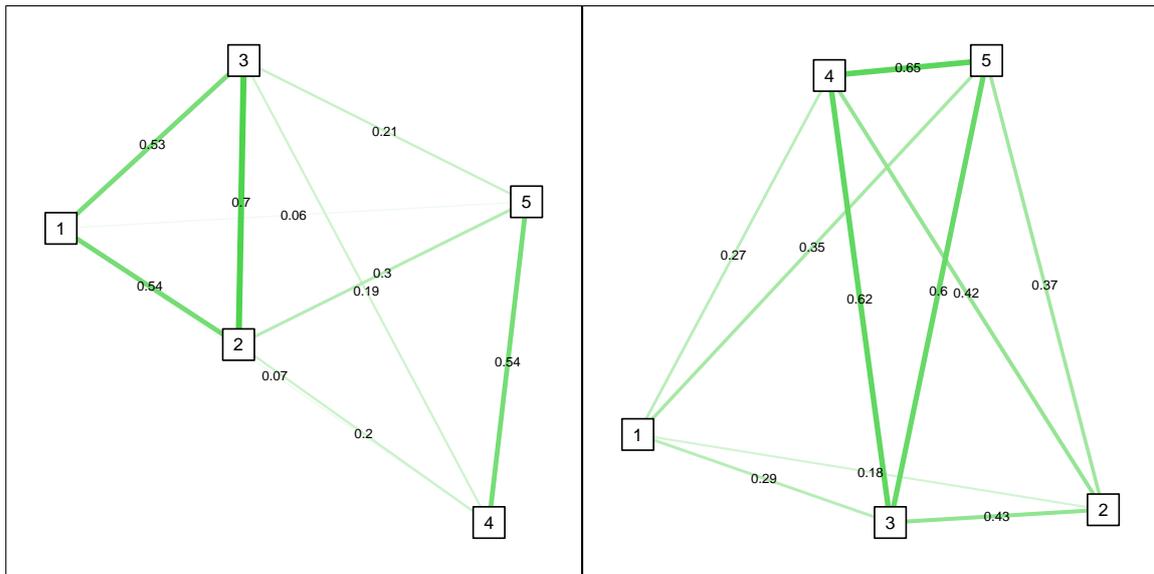**Day 2 exercises**

Network Analysis

Exercise 1

Below are two graphical representations of possible correlation matrices of measures of 100 subjects on these 5 manifest variables. Which of these correlation matrices is the most likely to have the single factor model underlying the data? And why?

Exercise 2

a. Make the following graph in qgraph (use `"circle"` layout), store the plot and include it in your report:
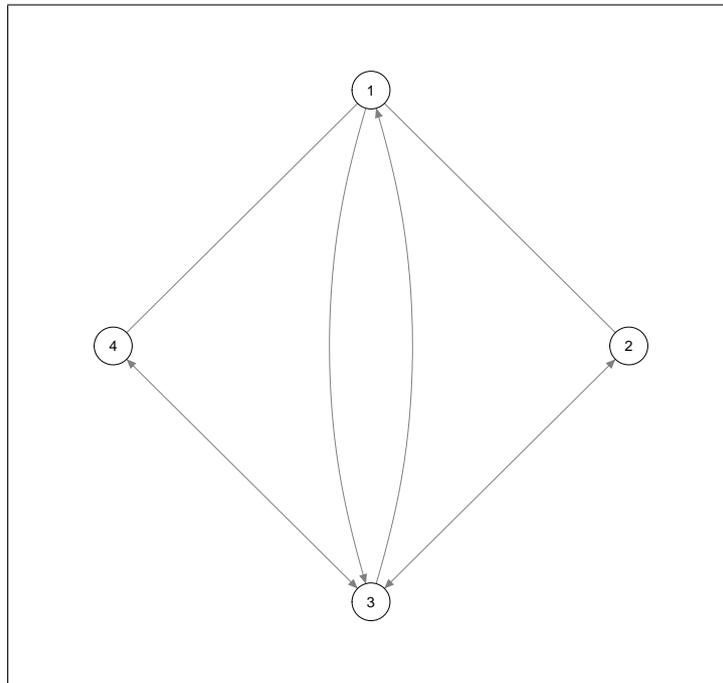
*b.* Below are two correlation matrices:

```
Cor1 <- structure(c(1, 0.52, 0.5, 0.52, 1, 0.54, 0.5, 0.54, 1),
    .Dim = c(3L, 3L), .Dimnames = list(c("a", "b", "c"), c("a",
        "b", "c")))
Cor2 <- structure(c(1, 0.32, -0.45, 0.32, 1, -0.01, -0.45, -0.01,
    1), .Dim = c(3L, 3L), .Dimnames = list(c("a", "b", "c"),
    c("a", "b", "c")))
```

Visualize both correlation matrices (use circular layouts). Include the graphs in your report and make sure that they are comparable.

Exercise 3

Read ? (?) before answering this question.

On blackboard you can find the SPSS file `abData.sav`. This contains 500 measurements on ten variables: a_1 to a_5 and b_1 to b_5. Suppose we assume that underlying this data are two correlated latent factors:
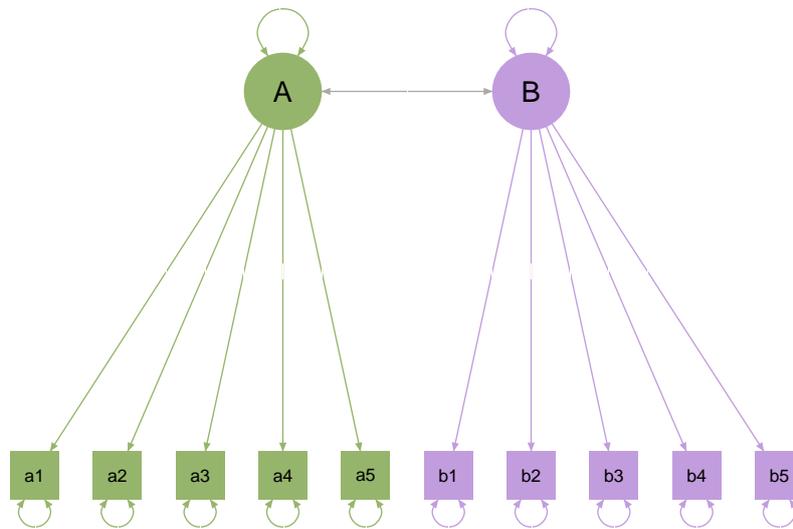
a. Import the data to R

b. Use qgraph to visualize the correlation matrices. Use a spring layout and identify the factors each node is suppose to load on with a color (All "a" variables should share a color, and all "b" variables should share a color). Save the plot and include it in your PDF report. Is this the correlational structure you expect to see in a two factor model? Why (not)?

c. Using qgraph, perform an exploratory factor analysis on the data, using two factors and the default (promax) rotation. Save the plot and include it in your PDF report.

d. Using qgraph, perform a confirmatory factor analysis on this dataset (set the used package to "lavaan", see help page of the function you use to see how to do that). Store the result in an object.

e. Install and load the package `semPlot`. You can use the function `semCors` on the CFA output object to obtain qgraph graphs of both the observed and implied correlation matrices. Save this plot and include it in your PDF report. What can you conclude about how well the two factor model describes this data?

f (optional: 1 bonus point). Use any SEM package you like (I recommend Lavaan, see especially its `cfa` function; ?, ?) to further analyze this data. Can you extend the two factor model to significantly improve the model-fit?

Challenge Exercise

The following script simulates data and produces a qgraph plot:

```
# Simulate data:
library("lavaan")
Mod <-
'
F =~ 0.5*a + 1*b + -0.3*c + 0.6*d + -0.7*e
'
set.seed(1)
Cors <- cor(simulateData(Mod))
# Plot and save qgraph:
library("qgraph")
Graph <- qgraph(Cors)
```
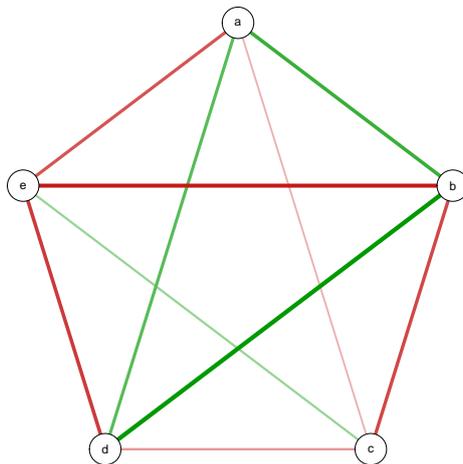

Inspect the output object, called `Graph` and write a function that takes this object as input and plots the same graph as above, uing only base R plotting functions (you only need `points()`, `lines()` and `text()`).

Start with:

```
mygraph <- function(Graph) {
    # Open plot
    plot(1, ann = FALSE, axes = FALSE, xlim = c(-1.2, 1.2), ylim = c(-1.2,
        1.2), type = "n", xaxs = "i", yaxs = "i")
    #### PLOTTING CODES ###
}
```

Only try to reproduce this graph, not any other qgraph plots. Make sure that at least:

- The graph structure is the same
- The nodes are placed at the same location
- The edges are of the same color and width

Tip: The columns of `Graph$layout` give you the x and y coordinates of every node.

References

Epskamp, S., Cramer, A. O. J., Waldorp, L. J., Schmittmann, V. D., & Borsboom, D. (2012). qgraph: Network visualizations of relationships in psychometric data. *Journal of Statistical Software*, *48*(4), 1–18. Retrieved from `http://www.jstatsoft.org/v48/i04/`

Rosseel, Y. (2012). lavaan: An R package for structural equation modeling. *Journal of Statistical Software*, *48*(2), 1–36. Retrieved from `http://www.jstatsoft.org/v48/i02/`