Symposium: Networks and Latent Variable Models: Distinctions and Combinations

Monday May 22, 11.00 – 13.00 in room G-1.11

As part of the research master course on structural equation modeling, but freely accessible to all who are interested, we have organized a mini-symposium on network models versus latent variable models. In this symposium, we will introduce the network perspective, and discuss recent research on combining and separating network models from latent variable models.

Schedule:

- 11.00 – 11.35: Eiko Fried – What are the appropriate statistical models for psychological constructs such as personality, intelligence, or mental disorders? An introduction to network and latent variable models.
- 11:35 – 12:10: Sacha Epskamp – Generalized Network Psychometrics: Combining Network and Latent Variable Models.
- 12:10 – 12:45: Abe Hofman – A comparison of latent variable vs network models using longitudinal data.

Presentation 1

Title
What are the appropriate statistical models for psychological constructs such as personality, intelligence, or mental disorders? An introduction to network and latent variable models

Presenting Author
Eiko Fried (eiko.fried@gmail.com)

Abstract
Many scholars have raised two related questions: What are psychological constructs (PCs) such as cognitions, emotions, attitudes, personality characteristics and intelligence? And what are the appropriate statistical models? In this brief overview talk I will distinguish between theories about PCs (e.g., PCs are natural, social, practical, or complex kinds) and appropriate statistical models (e.g. reflective or formative latent variable models, and network models), discuss how theory and models fit together, and how theory determines what models we should use.

References

Fried, E. I. (2017). What are psychological constructs? On the nature and statistical modeling of emotions, intelligence, personality traits and mental disorders. Health Psychology Review, 11(2), 130–13. http://doi.org/10.1080/17437199.2017.1306718

Presentation 2

Title
Generalized Network Psychometrics: Combining Network and Latent Variable Models

Presenting Author
Sacha Epskamp (mail@sachaepskamp.com)

Abstract
The formalization of the Gaussian graphical model (GGM), a popular undirected network model of partial correlation coefficients, as a formal psychometric model allows for its combination with the general framework of Structural Equation Modeling (SEM; Epskamp, Rhemtulla & Borsboom, in press). The GGM conceptualizes the covariance between psychometric indicators as resulting from pairwise interactions between observable variables in a network structure. This contrasts with standard psychometric models, in which the covariance between test items arises from the influence of one or more common latent variables. Here, we present two generalizations of the network model that encompass latent variable structures. In the first generalization, we model the covariance structure of latent variables as a network. We term this framework Latent Network Modeling (LNM) and show that, with LNM, a unique structure of conditional independence relationships between latent variables can be obtained in an explorative manner. In the second generalization, the residual variance-covariance structure of indicators is modeled as a network. We term this generalization Residual Network Modeling (RNM) and show that, within this framework, identifiable models can be obtained in which local independence is structurally violated. These generalizations allow for a general modeling framework that can be used to fit, and compare, SEM models, network models, and the RNM and LNM generalizations. This methodology has been implemented in the free-to-use software package lvnet, which contains confirmatory model testing as well as two exploratory search algorithms: stepwise search algorithms for low-dimensional datasets and penalized maximum likelihood estimation for larger datasets.

References

Epskamp, S., Rhemtulla, M.T., & Borsboom, D. (in press). Generalized Network Psychometrics: Combining Network and Latent Variable Models. *Psychometrika.* Pre-print available at arxiv.org/abs/1605.09288.

Presentation 3

Title
A comparison of latent variable vs network models using longitudinal data

Presenting Author
Abe Hofman (a.d.hofman@uva.nl)

Abstract
In psychology the correlational structure between items or subtests is often analyzed with latent variable models and more recently using different network modeling approaches. For example, in the study of intelligence a positive (cross-sectional) correlational structure - the positive manifold - is a well established empirical phenomenon which is often explained by introducing a general intelligence factor. Recent papers have shown that both latent variable and network models can result in the same observed correlational structures (and are in some cases even mathematically equivalent). However, these models differ greatly in their substantive explanations and imply that different mechanisms generated these correlations.

This talk presents a comparison of a network model and a latent variable model using longitudinal data. We use a longitudinal structural equation modeling framework and different specifications of latent change score models that can capture the implied dynamics of different developmental theories. Using data from a large online learning platform for mathematics (Math Garden), we show that the development of learning to do mathematics is best described by a network approach that allows direct links between the development of different domains (e.g. counting and addition).