UNIVERSITY
OF TWENTE.

Meeting of the Working Group Structural Equation Modeling

March 14-15, 2024

University of Twente

1 Conference venue

The meeting will be held at:

University of Twente
Building 12 (Waaier)
Room: Waaier 4 (Berkhoffzaal)
Hallenweg 25
7522 NH Enschede
The Netherlands

2 Local organizers

Jörg Henseler
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3 Directions

3.1 University of Twente

The University of Twente is located in the eastern part of the Netherlands, in the province of Overijssel. Its campus is situated in the Twente region, between the cities of Hengelo and Enschede (near the German border). Here you can find some information on how to get to the University of Twente.

3.2 Conference venue

The conference venue is at the Waaier building of the University of Twente, see number 12 on the campus map.

The meeting will take place in the room Waaier 4 (Berkhoffzaal). To reach the room, enter the Hal B building (no. 13 on the map) using the entrance opposite to Starbucks. Once you enter the Hal B building, walk towards the Service Desk and turn right to enter the Waaier building. Continue straight ahead and use the stairs on the left side to get to the first floor. The room Waaier 4 can be found here.

3.3 Campus tour

To better get to know the University of Twente, we are organizing a guided campus tour on 14 March at 17:45. The campus tour will start at the Waaier building (the conference venue) and will end at the U Parkhotel (the place of the conference dinner) at 19:15.

3.4 Conference dinner

The conference dinner will be held at the U Parkhotel on 14 March at 19:30. The U Parkhotel is a 10 minute away from the Horsttoren. The costs of 50 EUR need to be paid in cash at your arrival.

4 List of hotels

There are two hotels on or near the campus:

- U Parkhotel (on campus)
- Fletcher hotel (near the campus)

Alternatively, the IntercityHotel Enschede is located in the centre of Enschede (approx. 4 km from the campus). You can also find other hotels in Enschede or Hengelo (the campus is located between the two cities) on booking.com.

Considering the U Parkhotel, a contingent of 20 Comfort Twin rooms has been reserved for a stay from 13 to 15 March. The price for these rooms is 116 EUR per night per person including breakfast (2.90 EUR city tax not included). If you would like to take advantage of this opportunity, you must make your reservation by email (bookings@uparkhotel.nl) or by phone (+31 53 433 1366), using the following reference code GA000937. Reservations are made on a first-come, first-served basis and the offer is valid until 21 February. After this date (and of course also before), you can book rooms based on availability and regular rates will apply.

5 Timetable

March 14 (Thursday)

Time		Author(s) & Title
10:00 - 10:45		Registration
10:45 - 11:00		Welcome to Enschede!
11:00 - 11:30	01	*Tomasz Żółtak, Artur Pokropek, Peter Schmidt & Eldad Davidov* New and Established Methods to Test Moderation Effects in Latent Structural Equation Models: A Monte Carlo Simulation
11:30 - 12:00	02	*Artur Pokropek, Tomasz Żółtak & Marek Muszyński* Response Styles. Detection and Mitigation Using Latent Variable Models
12:00 - 12:30	03	*Tamara Schamberger & Jörg Henseler* Moderated Mediation with Composites: The H–O/LMS approach
12:30 - 13:30		Lunch buffet
13:30 - 14:00	04	*Marcus Eisentraut, Eldad Davidov, Leona Przechomski, Alisa Remizova & Peter Schmidt* Comparative Cross-National Assessment of Attitudes Toward Refugees in the European Social Survey
14:00 - 14:30	05	*Henrik Andersen & Jochen Mayerl* An Investigation of Reciprocal Effects Between Fear of Crime and Support for Right-Wing Populism
14:30 - 15:00	06	*Sara van Erp, Paul Bürkner & Aki Vehtari* Projection predictive variable selection for Bayesian regularized SEM
15:00 - 15:30		Coffee break
15:30 - 16:00	07	*Njål Foldnes, Steffen Grønneberg & Jonas Moss* Improved goodness of fit procedures for confirmatory factor analysis
16:00 - 16:30	08	*Eric Klopp* Some considerations about the model-size effect
16:30 - 17:00	09	*Dominik Becker* A simulation analysis of doubly-latent formative measurement models
17:00 - 17:30		Meeting of the Working Group SEM
17:45 - 19:15		Campus tour
19:30		Conference dinner

March 15 (Friday)

Time		Author(s) & Title
9:00 - 9:30	10	*Mark de Rooij* SEM-Based Out-of-Sample Predictions
9:30 - 10:00	11	*Ethan M. McCormick, Patrick J. Curran & Gregory R. Hancock* Latent Growth Factors as Predictors of Distal Outcomes
10:00 - 10:30	12	*Zachary Roman, Patrick Schmidt, Jason Miller & Holger Brandt* An Empirical Data-set for Bench-marking Latent Variable Approaches for Careless and Insufficient Effort Responding; Exemplified with a Dynamic Structural Equation Model
10:30 - 11:00	Coffee break	
11:00 - 11:30	13	*Jasper Bogaert, Wen Wei Loh & Yves Rosseel* Correlation Preserving Factor Score Regression: An Alternative for SEM?
11:30 - 12:00	14	*Franz Classe, Christoph Kern & Rudolf Debelak* Computation of Model Scores for Multidimensional Item Response Theory Models fitted with the WLS estimator
12:00 - 12:30	15	*Steffen Grønneberg* Sum score asymptotics
12:30 - 13:30	Lunch buffet	
13:30 - 14:00	16	*Terrence D. Jorgensen & Aditi Manoj Bhangale* Two-Stage Estimation of SEM Parameters for Social Relations Data
14:00 - 14:30	17	*Aditi Manoj Bhangale & Terrence D. Jorgensen* Impact of prior information on two-stage maximum likelihood estimates of social-relations structural equation model parameters
14:30 - 15:00	18	*Kento Okuyama, Tim Fabian Schaffland, Pascal Kilian, Holger Brandt & Augustin Kelava* Frequentist forecasting in regime-switching models using filtering and machine learning
15:00 - 15:30	Coffee break	
15:30 - 16:00	19	*Zeynep Şiir Bilici, Mike Cheung & Suzanne Jak* Evaluating robust variance estimation in MASEM
16:00 - 16:30	20	*Lennert J. Groot, Kees Jan Kan & Suzanne Jak* In Between Methods: Evaluating Approaches for Individual Participant Data Meta-Analytic Structural Equation Modeling
16:30 - 17:00	Closing	

6 Abstracts of Presentations

01 New and Established Methods to Test Moderation Effects in Latent Structural Equation Models: A Monte Carlo Simulation

Tomasz Żółtak[1], Artur Pokropek[1], Peter Schmidt[2,3], Eldad Davidov[4,5]

[1]Institute of Philosophy and Sociology of the Polish Academy of Sciences
[2]Department of Political Sciences, University of Giessen
[3]University of Mainz
[4]Institute of Sociology and Social Psychology, University of Cologne
[5]URPP Social Networks and Department of Sociology, University of Zurich

Moderation effects are central parts in various psychological theories (e.g. Fishbein & Ajzen, 2011; Hagger et al., 2022). In our presentation we will cover results of a simulation study comparing different methods in SEM to estimate latent interactions. We compared a wide range of methods: mean and residual-centered unconstrained approach estimated using either ML, SAM or MIIV/TSLS methods (using the R packages lavaan and miivsem), LMS estimated using ML and Bayesian methods (in Mplus), as well as PLS (using the R package seminr). Moreover, we studied a diverse and large set of conditions with up to three interaction terms included in the model. Our simulation design varied also with respect to the sample size, the reliability of constructs under consideration and the strength of the structural coefficients. All conditions in our simulation design were chosen to reflect real-life survey research scenarios and taking into account solution criteria like negative variances, ensuring that the results will apply to practical research. Based on our simulation results we provide differentiated recommendations for researchers testing moderation effects.

02 Response Styles. Detection and Mitigation Using Latent Variable Models

Artur Pokropek[1], Tomasz Żółtak[1], Marek Muszyński[1]

[1]Computational Social Science Department Institute of Philosophy and Sociology of Polish Academy of Sciences

In the social sciences, using Likert-type scales in questionnaires is a common method for measuring latent constructs such as opinions, attitudes, or values. While this approach is convenient for quantitative analysis, it encounters potential challenges because different groups of respondents might use the response categories inconsistently. This is known as response styles (RS), defined as construct-irrelevant, patterned responses that do not reflect the intended construct to be measured. The presentation will address the problem of threats to the validity of SEM analyses, which the occurrence of varied RS may pose to self-report survey questions. This problem will be presented concerning two psychometric models most commonly used to take into account the diversity of response styles among respondents: the so-called IRTrees and MNRM (Multidimensional Nominal Response Models). The presentation will include the results of a simulation study considering the issues of detecting the RS and the consequences of ignoring RS, and it will show how RS models could be incorporated into SEM modeling. Results indicate that RS can significantly bias SEM models under certain conditions, but detecting RS and mitigating RS is not a major issue for correctly specified SEM models. The simulation study will be supplemented by presenting the results of analyses using actual data from the international survey of adult skills PIAAC.

03 Moderated Mediation with Composites: The H–O/LMS approach

Tamara Schamberger[1,2], Jörg Henseler[2,3]

[1]Bielefeld University, Faculty of Business Administration and Management, Bielefeld, 33615, Germany
[2]University of Twente, Department of Design, Production and Management, Enschede, 7500 AE, The Netherlands
[3]Universidade Nova de Lisboa, Nova Information Management School, Campus de Campolide, 1070-312 Lisboa, Portugal

A theoretical concept in social sciences can be modeled in two ways: as a latent variable, i.e., a common factor that explains the covariance structure of its related variables, or as an emergent variable, i.e., a composite that conveys all the information between its components and the other variables in the model. A composite is particularly useful if the theoretical concept is formed by humans, e.g., socio-economic status, emotional inventory, or social intervention. In a structural equation model, composites can occur in various places in the structural model: as independent variables, as dependent variables, as mediator variables, and as moderator variables. However, existing approaches to specifying composites in structural equation modeling (SEM) restrict the position of composites in the structural model or do not allow the model parameters to be estimated using methods known via SEM with latent variables. Against this background, we present a novel approach to analyzing moderated mediation effects with composites, which we call H–O/LMS. H–O/LMS blends the recently introduced Henseler–Ogasawara (H–O) specification, which allows composites to be included in a structural equation model as mediators, with latent moderated structural equations (LMS). Further, our approach enables estimating the model parameters using methods used in SEM with latent variables: if composites are modeled as mediators, the model parameters can be estimated with a maximum likelihood approach; if composites are involved as moderators, our approach allows us to estimate the model parameters with the LMS approach.

04 Comparative Cross-National Assessment of Attitudes Toward Refugees in the European Social Survey

Marcus Eisentraut[1], Eldad Davidov[1,2], Leona Przechomski[1], Alisa Remizova[3], Peter Schmidt[4,5]

[1]Institute of Sociology and Social Psychology, University of Cologne
[2]URPP Social Networks and Department of Sociology, University of Zurich
[3]GESIS - Leibniz Institute for the Social Sciences
[4]Justus Liebig University Giessen
[5]Johannes Gutenberg University Mainz

The relevance of understanding public perceptions of refugees in various countries, particularly in Europe, has surged notably since 2015, and it is expected to persist as a critical global issue. Thus, the ability to gauge attitudes toward refugees uniformly across different nations has become increasingly essential. However, to the best of our knowledge, a systematic cross-national analysis of the comparability of various measures of attitudes toward refugees is missing. This study addresses this significant gap by providing a cross-cultural comparative analysis of the measurement of attitudes toward refugees across diverse languages and countries. For the analysis we use data from the first round (2002) of the European Social Survey (ESS). Although these data are relatively old, the measures of attitudes toward refugees included in the survey are detailed. Newer ESS data have included several measures of immigration, but they lack

such a detailed scale for refugees. Thus, our findings could provide clues as to which items are particularly suitable for comparing attitudes toward refugees across countries, enabling a nuanced understanding of public opinion on the topic. Utilizing different approaches to measurement invariance testing, including confirmatory factor analysis and the alignment method, we found that several items used in the ESS are highly comparable and may be used to compare attitudes toward refugees in a meaningful way across several European countries. Therefore, we recommend the incorporation of these items in future international surveys, like the ESS, to enable a more comprehensive examination of attitudes towards refugees, their causes and consequences.

05 An Investigation of Reciprocal Effects Between Fear of Crime and Support for Right-Wing Populism

Henrik Andersen[1], Jochen Mayerl[1]

[1]Institute of Sociology, Chemnitz University of Technology

Right-wing populism (RWP) is a growing concern in many liberal democracies as it threatens democratic institutions, promotes anti-intellectualism, leads to paranoid conspiracy thinking, and promotes racist stere-otypes and fear. For these reasons, it is important to understand the causes of RWP support. Explanations for RWP support broadly come in two forms: (1) demand-side explanations that focus on economic (e.g., Losers of Modernization) and cultural concerns (e.g., Cultural Backlash) of individuals, and (2) supply-side explanations that look at institutional and party-related characteristics of the political landscape. These competing theoretical frameworks raise the question of *whether RWP success is the product of bot-tom-up demand or rather of top-down supply processes*. In this context, we ask whether one of the core features of RWP in Europe, *fear of criminal migrants*, is demand or supply driven. Put differently, is it the case that a fear of criminal migrants existed *organically* in the population and RWPs has moved in to fill this demand? Or is it rather the case that RWPs, through its political appeals and style of discourse has created fear *artificially* amongst people susceptible to their appeals? We propose an empirical investigation of the reciprocal effects of fear of crime and support of RWP to establish the causal predominance between the two constructs. With longitudinal data, we will work with fixed effects cross-lagged panel models to investigate reciprocal effects while controlling for stable sources of unobserved heterogeneity. We discuss current methodological issues associated with the investigation of reciprocal effects and present our substantive results.

06 Projection predictive variable selection for Bayesian regularized SEM

Sara van Erp[1], Paul Bürkner[2], Aki Vehtari[3]

[1]Utrecht University
[2]TU Dortmund University
[3]Aalto University

Classical regularized structural equation modeling (SEM) relies on optmization with a penalty function added to the usual estimation problem. An alternative to the classical approach is Bayesian regularized SEM in which the prior distribution serves as penalty function. Many different shrinkage priors exist, enabling great flexibility in terms of shrinkage behavior. Additionally, advantages in terms of automatic uncertainty estimates, the possibility to include

prior knowledge, and intuitive interpretation of the results have resulted in various applications of Bayesian regularized SEM. The goal of Bayesian regularized SEM is often to select a more parsimonious model by including only those parameters in the model which show substantial effects after regularization. Currently, ad-hoc methods are used in SEM to decide if a parameter estimate should be set to zero or not for example by relying on an arbitrary threshold value or on the 95% credibility interval. However, it has been shown that the optimal selection criterion depends on various sample and model characteristics. Thus, a formal selection method that works well across different types of SEMs and conditions is needed. A promising method that is available in regression models is projection predictive variable selection, which offers a practical approach of selecting the model that offers nearly similar predictions as a reference model. In this presentation, I will present an extension of the projection predictive method to SEM to determine which parameter estimates to set to zero, thereby performing automatic model selection.

07 Improved goodness of fit procedures for confirmatory factor analysis

Njål Foldnes[1], Steffen Grønneberg[2], Jonas Moss[2]

[1]University of Stavanger
[2]BI Norwegian Business School

We propose and evaluate new ways of robustifying goodness-of-fit tests for confirmatory factor models and structural equation modeling under non-normality. These test statistics have limit distributions characterized by eigenvalues whose estimates are highly unstable and biased in known directions. To take this into account, we design model-based trend predictions to approximate the population eigenvalues. We evaluate the new procedures in a large-scale simulation study. Some of the new procedures markedly outperform the Bollen–Stine bootstrap, the Satorra–Bentler scaling, and the scaled and shifted test. Also, the Satorra–Bentler test performed the best when used with the unbiased gamma estimator and the RLS statistic. We demonstrate how the new tests are calculated with a new R package and provide practical recommendations.

08 Some considerations about the model-size effect

Eric Klopp[1]

[1]Department of Education, Saarland University

The model-size effect means that for models with latent variables, the model's asymptotically χ^2-distributed test statistic is upwardly biased depending on the size of the model, in particular, for small sample sizes. Drawing on statistical theory and the distinction between error of approximation and error of estimation, we reconsider some up-to-now neglected factors. We argue that the model-size effect appears only in correctly specified models. For correctly specified models, the expectancy of the test statistic equals the number of degrees of freedom. Because there is only error of estimation that decreases with increasing sample size, the test statistic is upwardly biased for small sample sizes. However, for misspecified models, there is both error of approximation and error of estimation. Therefore, the test statistic should be above the expectancy and, following statistical theory, should increase with increasing sample size and an increasing degree of misspecification. Thus, the model-size effect applies only to correctly specified models and means that for small samples size, the test statistic is above its expectancy.

Up-to-now neglected are the sizes of the manifest residual variances that also affect the test statistic: the smaller the manifest residual variance, the larger the upward bias in correctly specified models. However, for misspecified models, large manifest residual variances decrease the test statistic by masking the misfit, especially for small sample sizes. We demonstrate the above-mentioned behavior issues using simulations and discuss the implications.

09 A simulation analysis of doubly-latent formative measurement models

Dominik Becker[1]

[1]Federal Institute for Vocational Education and Training (BIBB)

In latent variable theory, reflective models refer to latent variables that cause their manifest indicators (e.g., intelligence), while formative models assume the latent variable to be caused by its manifest indicators (e.g., socio-economic status). Apart from measurement error, an additional source of bias emerges when latent variables shall be measured on multiple analysis levels. Previous research has shown that naïve (i.e., manifest) aggregation of lower-level (L1) latent (or manifest) variables on the contextual level (L2) may yield biased results. This can be circumvented via latent aggregation by which L2 latent variables are estimated from L1 manifest indicators. Previous research has predominantly focused on latent aggregation within reflective measurement models. In this contribution, I explore potential sources of bias when the predictors of interest are assumed to be formative. To do so, I will simulate formative latent predictor variables on both analysis levels (X_1 and X_2) that are derived from three manifest L1 variables ($x_{1.1}$-$x_{1.3}$). I will then generate a reflective L1 latent outcome variable (Y_1) that is estimated from three L1 manifest variables ($Y_{1.1}$-$Y_{1.3}$). Both X_1 and X_2 correlate with Y_1 by correlation coefficients $\rho(X_1,Y_1)$ and $\rho(X_2,Y_2)$. In the data-generating process, I will vary both factor loadings of the latent variables and their intercorrelations. The resulting data will be analyzed comparing results from 1) *manifest* vs. 2) *latent measurement* – where the latter distinguishes between 2a) *reflective* vs. 2b) *formative measurement* –, and 3) *manifest* vs. 4) *latent aggregation*. Simulation analyses will be amended by an applied example using real-world data.

10 SEM-Based Out-of-Sample Predictions

Mark de Rooij[1]

[1]Methodology & Statistics department, Leiden University

Predictive modeling is becoming more popular in psychological science. Machine learning techniques have been used to develop prediction rules based on items of psychological tests. However, this approach does not take into account that these items are noisy indicators of the constructs they intend to measure. Structural equation modeling does take this into account. Several authors have concluded that it is impossible to make out-of-sample predictions based on a reflective structural equation model. We show that it is possible to make such predictions and we develop R-code to do so. With two empirical examples, we show that SEM-based prediction can outperform prediction based on linear regression models. With three simulation studies, we further investigate the SEM-based prediction rule and its robustness in comparison with predictions using regularized linear regression. We conclude that the new SEM-based prediction rule is robust against violation of the normality assumption but sensitive to model misspecification.

11 Latent Growth Factors as Predictors of Distal Outcomes

Ethan M. McCormick[1], Patrick J. Curran[2], Gregory R. Hancock[3]

[1]Methodology and Statistics Department, Leiden University
[2]Department of Psychology and Neuroscience, University of North Carolina at Chapel Hill
[3]Department of Human Development and Quantitative Methodology, University of Maryland

A currently overlooked application of the latent curve model (LCM) is its use in assessing the consequences of development patterns of change – that is as a predictor of distal outcomes. However, there are additional complications for appropriately specifying and interpreting the distal outcome LCM. Using simulated and real data examples, our first investigation focused on developing a general framework for understanding the sensitivity of the distal outcome LCM to the choice of time coding, focusing on the regressions of the distal outcome on the latent growth factors. We highlighted the unexpected changes in the regression on the slope factor which stand in contrast to prior work on time coding effects, and develop several techniques (including an aperture and factor-prioritization) to obtain consistently-interpretable estimates of the effect of the slope. Throughout, we emphasize practical steps for understanding these changing predictive effects, including graphical approaches for assessing regions of significance similar to those used to probe interaction effects. In this talk, I will outline next directions in this work, including: understanding how these time coding effects impact mediation, moderation, and parallel growth process analyses, extensions to higher order linear models (e.g., quadratics, piecewise), as well as distal outcomes within linearized SEMs (e.g., Preacher & Hancock, 2015, *Psychol. Methods*; McCormick, preprint).

12 An Empirical Data-set for Bench-marking Latent Variable Approaches to Careless and Insufficient Effort Responding; Exemplified with a Dynamic Structural Equation Model

Zachary Roman[1], Patrick Schmidt[1], Jason Miller[2], Holger Brandt[3]

[1]University of Zurich
[2]University of Northern Georgia
[3]University of Tuebingen

Recently latent variable literature has seen a rise in approaches aimed at accounting for Careless and Insufficient Effort Responding C/IER. We established one such novel approach utilizing Dynamic Structural Equation Modeling (DSEM), in Roman, Schmidt, Miller, and Brandt (in review). Our approach allows for the estimation of item level C/IER, which we argue is more realistic than subject level C/IER. Further, in this work we argue that while simulation research is a good means to validate these models, C/IER in the real world is likely expressed more diversely. To explore a more human expression of C/IER we conducted an in which we induce C/IER behavior. This was accomplished by giving participants in experimental conditions instructions at a random point in the survey to "Finish the survey as fast as possible without considering the item content", or "Finish the survey as fast as possible without considering the item content, but make it look like you did". The data comprises a personality inventory with 10 latent factors, 10 items each, collected for 1,002 subjects. While the approach we establish, does not rely on response times or bogus items, both are also present in the data. We believe the experimental data serves well as a bench-mark test for comparing the performance of approaches to C/IER. We have created an R package to make the data accessible to other researchers. In this talk we will outline data collection, introduce the R package, followed

by exemplifying usage with the DSEM approach in Roman, Schmidt, Miller, and Brandt (in review).

13 Correlation Preserving Factor Score Regression: An Alternative for SEM?

Jasper Bogaert[1], Wen Wei Loh[2], Yves Rosseel[1]

[1]Department of Data Analysis, Ghent University
[2]Department of Quantitative Theory & Methods, Emory University

Researchers in behavioral sciences often aim to analyze relationships among latent variables. Structural Equation Modeling combined with Joint Maximum Likelihood Estimation (SEM-ML) is widely regarded as the gold standard for this purpose. A straightforward alternative for estimating the parameters of the structural model is Uncorrected Factor Score Regression (UFSR), where factor scores are computed and subsequently employed in regression or path analysis. The most popular factor scores are the Regression and Bartlett factor scores, which were constructed to minimize the mean squared error or achieve unbiasedness on the individual level, respectively. Nevertheless, these factor scores are contaminated by random measurement error and using these will lead to biased estimates and invalid inferences. In recent years, Factor Score Regression (FSR) has enjoyed several methodological advancements to address this inconsistency. Methods like Bias-Avoiding Factor Score Regression (BAFSR) and the Method of Croon (MOC) have been developed and extended for various purposes. However, the utilization of correlation-preserving factor scores to obtain unbiased estimates of the structural model parameters has been largely overlooked. Our objective is to assess whether Correlation Preserving Factor Score Regression (CPFSR) is a viable alternative to SEM-ML and MOC. For this purpose, we conducted a simulation study comparing (i) SEM-ML, (ii) MOC, (iii) UFSR, (iv) BAFSR, and (v) CPFSR in terms of bias, efficiency, and hypothesis testing. Preliminary results indicate that CPFSR performs comparably well to SEM and MOC. While UFSR exhibited the highest efficiency, it also demonstrated biased estimates and inflated type I error rates.

14 Computation of Model Scores for Multidimensional Item Response Theory Models fitted with the WLS estimator

Franz Classe[1], Christoph Kern[2], Rudolf Debela[3]

[1]Deutsches Jugendinstitut e.V., Nockherstraße 3, 81541 Munich
[2]Institut für Statistik, Ludwigs-Maximilians Universität München, Ludwigstr. 33, 80539 München
[3]Psychologisches Institut der Universität Zürich, Binzmühlestrasse 14, CH-8050 Zürich

In this paper, we present the R package `estfunWLS` designed for computing model scores for multidimensional item response theory (MIRT) models, particularly multidimensional Graded Response Models, estimated with the Weighted Least Squares (WLS) estimator. The WLS estimator allows fast estimation of intricate MIRT model parameters through the limited information approach. The new R package makes it possible to compute model scores, i.e., the first-order derivatives of the objective function, for models fitted with the WLS estimator. This way, the package facilitates rapid execution of numerous parameter instability tests for MIRT models. The efficient computation of parameter instability tests is crucial for various applications, such as model-based recursive partitioning algorithms. Such algorithms may be used to detect groups of subjects exhibiting Differential Item Functioning (DIF) which are not

pre-specified but result from combinations of covariates. We performed a comparative analysis of the performance of parameter stability tests for models fitted with a limited information approach (here: the WLS estimator) using the `lavaan` package vs. those fitted with a full information approach using the `mirt` package. The new approach has a good Type I error rate, high power, and is computationally faster than analysis via `mirt`.

15 Sum Score Asymptotics

Steffen Grønneberg[1]

[1]Department of Economics, BI Norwegian Business School, Oslo, Norway

We prove new results on the convergence of the mean score for integer-encoded ordinal data under a non-parametric factor model assumption. In applications, sum scores are often inputted to correlation based statistical methods as a proxy for the latent variable the scale measures. This will only be valid if the standardized sum scores are close to the standardized latent variable. We show that this will only hold under very strong assumptions, and identify a new assumption which allows the estimation of correlations of latent variables when assuming knowledge of the marginal distributions of the latent variables.

16 Two-Stage Estimation of SEM Parameters for Social Relations Data

Terrence D. Jorgensen[1], Aditi Manoj Bhangale[1]

[1]University of Amsterdam

It is becoming increasingly common for researchers to study social phenomena from an interpersonal perspective, using data gathered from a round-robin design, in which each member of a group (e.g., a nuclear family, classroom, or team of employees) provides data about every other member. For example, each student in a classroom can indicate how much they like each other student. Dyadic data from this design have a complex underlying structure because each dyad is cross-nested within both members, given that each of N members provides information about $N - 1$ members, as well as having information provided about them by $N - 1$ members. The social relations model (SRM) was designed to decompose interpersonal perceptions (or behaviors) into random effects associated with perceivers (or actors), targets (or partners), and the uniqueness of particular relationships. The primary outcomes of an SRM analysis involve the estimated covariance matrices at the personal level (individual differences in actor and partner effects, and how they are correlated within persons) and the dyad level (e.g., how relationship-specific behaviors differ across dyads, given person-level effects). Thus, it is conceptually possible to model complex associations among multiple round-robin variables by fitting a structural equation model (SEM) to model the covariance structure at one or both levels of interest. This presentation will showcase an in-progress R package that facilitates a 2-step approach: (1) estimating a multivariate SRM using MCMC estimation and (2) using the `lavaan` package to fit an SEM with ML estimation.

17 Impact of prior information on two-stage maximum likelihood estimates of social-relations structural equation model parameters

Aditi Manoj Bhangale[1], Terrence D. Jorgensen[1]

[1]University of Amsterdam

The social relations model (SRM) is applied to examine multivariate dyadic data (e.g., round-robin data) within social networks. Such data have a unique nesting structure in that dyads are cross-classified within individuals who may be nested within different social networks. The SRM decomposes perceptual measures into multiple individual- and dyad-level components (incoming, outgoing, and relationship effects), the associations among which were previously estimated using linear random-effects models. However, such models cannot estimate complex structural relations between SRM components of different variables, for which one might use a structural equation model (SEM). The social-relations SEM (SR-SEM) combines the SRM and SEM, enabling researchers to test several measurement and structural hypotheses regarding SRM components. A recently proposed single-stage maximum likelihood estimation (MLE) algorithm is implemented in the R package `srm`. We propose a novel two-stage MLE technique that would overcome some existing limitations (e.g., computational burdens, assuming multivariate normality). Stage 1 of the estimator is Markov chain Monte Carlo estimation of unrestricted SRM summary statistics. Stage 2 is MLE of constrained SEMs using Stage-1 results as input, incorporating uncertainty about Stage-1 estimates to adjust Stage-2 *SE*s and test statistics. In a previous simulation with uninformative priors, we found inaccurate Stage-1 results that negatively impacted the (in)accuracy of Stage-2 results (i.e., "garbage in, garbage out"). We report the results of a follow-up simulation study that manipulated empirically informed priors in Stage 1, to compare the accuracy and efficiency of Stage-2 estimates with single-stage MLE.

18 Frequentist forecasting in regime-switching models using filtering and machine learning

Kento Okuyama[1], Tim Fabian Schaffland[1], Pascal Kilian[1,2], Holger Brandt[1] & Augustin Kelava[1]

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Digital technology allows for an assessment of intensive longitudinal data (ILD) across various domains. Psychological change processes, such as university student dropout in math, often exhibit discrete latent state transitions and can be studied using regime-switching models. Recently, regime-switching state-space (RSSS) models have been extended to allow for latent variables and their autoregressive effects. Despite this progress, estimation methods for handling both intra-individual changes and inter-individual differences as predictors of the discrete latent regime switches need further exploration. Specifically, there's a need for frequentist estimation methods in dynamic frameworks that allow real-time inferences and forecasts of latent or observed variables during ongoing data collection. Building on Chow and Zhang's (2013) extended Kim filter, we introduce a first frequentist filter for nonlinear RSSS models which allows hidden Markov(-switching) models to depend on both within- and between-individual characteristics. Unlike Kelava et al.'s (2022) Bayesian forecasting filter for nonlinear dynamic latent class structural equation models (NDLC-SEM), our proposed method is the first frequentist approach within this general class of models. The functionality of the filter is evaluated through simulation studies. In an empirical study, the filter is applied to forecast emotions and

behavior related to dropout.

19 Evaluating robust variance estimation in MASEM

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Dependent effect sizes in meta-analysis are quite common; studies may measure the same constructs across different time points, using different operationalization strategies or by using multiple informants. In the context of meta-analytic structural equation modeling (MASEM), when we have multiple effect sizes available for the same relationship in the same study, some of the methods used in the context of traditional meta-analysis are still applicable, such as aggregation, elimination and ignoring dependency. Previous simulation results comparing these methods showed that there is not one method that performs well across different conditions and evaluation criteria. Robust variance estimation (RVE) suggests an alternative approach, whereby the covariances in sampling errors of the dependent effect sizes are estimated by averaging the cross-products of residuals within each study (Hedges et al., 2010). By integrating a SEM model in multivariate meta-analysis with robust variance estimation, we aim to assess the problem of dependent correlations in MASEM. The current simulation study assesses the performance of RVE across conditions of varying number of studies, number of dependent effect sizes within studies, the magnitude of the correlation between the dependent effect sizes and the between studies variance.

20 In Between Methods: Evaluating Approaches for Individual Participant Data Meta-Analytic Structural Equation Modeling

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Researchers conducting meta-analytical structural equation modeling (MASEM) using raw data have several analysis options to choose from. Cluster-robust estimation, two-level structural equation modeling (SEM), multivariate meta-analysis of path coefficients, and One-Stage MASEM (OSMASEM) are some of these options. Two-level SEM explicitly separates effects at the within-study level from the between-study level, and OSMASEM look at the within- study effects, while cluster-robust method estimates an overall path coefficient, which essentially is a mix of within-study and between-study effects. Of these, cluster-robust estimation is often used in practice. A comparison of these methods using real-world data, however, shows that cluster-robust estimates deviate from results of other methods. Simulations using a factor model have shown that cluster-robust estimation may not always be free of bias. This study evaluates bias in parameter estimates and standard errors of MASEM methods with raw data in the context of path analysis, using simulated data. We varied equality of variance-covariance structure over the within-study and between-study level, intraclass correlations, number of primary studies being meta-analyzed, and missing data. Results are expected to show that cluster-robust estimation method yields significant bias in estimated path coefficients in certain conditions.