27th IOPS Summer Conference

8-9 June 2017

Leuven

Conference venue:	Justus Lipsiuszaal (LETT 08.16) Erasmushuis, Blijde-Inkomststraat 21, 3000 Leuven
Dinner:	Bistro Julia en Elias Busleidengang 6D, 3000 Leuven

Emergency Number KU Leuven:+32 (0)16 32 2222

Program prior to the conference Thursday 8 June

10:30-12:00 IOPS Board Meeting (Room LETT 06.15)

Program Thursday 8 June

12:00-13:00 Registration/Lunch (entrance hall - ground floor)

13:00-13:15 IOPS PhD student meeting

13:15-13:30 Official opening by Rob Meijer, IOPS director

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13:55-14:20 **Chris Hartgerink,** Tilburg University
Validity of using statistics to detect data fabrication **9**

14:20-14:45 **Kirsten Bulteel,** KU Leuven
Improved insight into network dynamics by combining VAR and dimension reduction **11**

14:45-15:15 Break (entrance hall - ground floor)

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15:40-16:40 **Invited speaker Paul De Boeck**,
The Ohio State University & KU Leuven
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16:40-17:00 IOPS plenary meeting

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Exhibition of Shiny apps developed for the TquanT project

19:00- Conference dinner at Bistro Julia & Elias

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11:15-11:40	**Pia Tio,** Tilburg University & University of Amsterdam *Estimating cross-source relationships from big data using component- and networks-analysis*	**23**
11:40-12:05	**Alexandra de Raadt**, University of Groningen *Properties of Cohen's kappa*	**25**
12:05-12.50	**Wolf Vanpaemel,** KU Leuven *Prior predictive modelling in psychology*	**27**
12:50-13:00	Closing by Rob Meijer, IOPS director	
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Computer intensive methods for testing model fit

Geert van Kollenburg (Tilburg University)

The assessment of model fit is an important part of statistical analysis. The researchers' interest may lie with specific aspects of a model, or in the global aggregated fit. Asymptotic p-values are not available for every conceivable statistic and even when they are available they may not be valid when sample sizes are not very large. To get more reliable p-values, researchers may resort to resampling methods. Some of these methods are time consuming, while others may provide p-values which are not uniform under the null-hypothesis. The most common resampling methods to test model fit will be illustrated in Latent Class analysis and linear regression analysis. A recently proposed calibration of the posterior predictive p-value, will be discussed. Finally, a very fast new resampling scheme is presented, which does not require multiple model estimations.

Student discussant: *Mattis van den Bergh*
Staff discussant: *Tom Wilderjans*

Validity of using statistics to detect data fabrication

Chris Hartgerink (Tilburg University)

We investigate the performance of general statistical methods to detect data anomalies due to data fabrication. With these methods, we tried to discern genuine- and fabricated data in two studies, focusing on either summary results or raw data. Because we do not know how researchers fabricate data, we asked actual researchers to fabricate data for experimental studies instead of simulating datasets ourselves. The results indicate that there is a clear heuristic for detecting data fabrication in papers: too large effect sizes. The presentation will provide an overview of these methods and their efficacy.

Student discussant: *Robbie van Aert*
Staff discussant: *Eva Ceulemans*

Improved insight into network dynamics by combining VAR and dimension reduction

Kirsten Bulteel (KU Leuven)

To understand within-person psychological processes, a VAR(1) model is often fitted to time series and the resulting VAR(1) coefficients are displayed in a network figure. However, this approach is not without problems. First, we often expect substantial contemporaneous correlations between the variables, yielding multicollinearity problems and thus unstable regression estimates. Second, the VAR(1) coefficients offer a fairly limited insight in the dynamics because the regression coefficients only capture unique direct effects of the variables and not the shared effects. In addition, the network figure is uninterpretable when the number of variables is large. In this paper, we show that the strategies that have been proposed in dynamic network analysis --the use of relative importance metrics, and applying the lasso-- are unsatisfactory. As a way out, we propose to combine dimension reduction of the variables and VAR(1) modeling. We will inspect two possibilities: The novel easy-to-apply principal components VAR(1) (PC-VAR(1)) model, and exploratory process factor analysis (EPFA), a dynamic factor analysis counterpart of PC-VAR(1). By means of an application, we show that the networks based on PC-VAR(1) or EPFA give a more informative representation of both the lagged and the contemporaneous relations among the variables.

Student discussant: *Merijn Mestdagh*
Staff discussant: *Sacha Epskamp*

Latent class trees

Mattis van den Bergh (Tilburg University)

Researchers use latent class analysis to derive meaningful clusters from sets of categorical observed variables. However, especially when the number of classes required to obtain a good fit is large, interpretation of the latent classes in the selected model may not be straightforward. To overcome this problem, we propose an alternative way of performing a latent class analysis, which we refer to as latent class tree modelling. For this purpose, we use a recursive partitioning procedure similar to those used in divisive hierarchical cluster analysis; that is, classes are split until the model selection criterion indicates that the fit does no longer improve. The key advantage of the proposed latent class tree approach compared to the standard latent class analysis approach is that it gives a clear insight into how the latent classes are formed and how solutions with different numbers of classes are linked to one another. We also propose measures to adjust the tree in certain conditions, extend the method for longitudinal data and show how to relate class membership with external variables. Empirical examples will be used to clearly illustrate the benefits of latent class trees.

Student discussant: *Jed Cabrieto*
Staff discussant: *Dylan Molenaar*

How ordinal are responses on ordinal response scales?

Paul De Boeck (The Ohio State University & KU Leuven)

More and more studies indicate that responses on ordinal response scales such as Likert scales are multidimensional. Different latent variables seem to play a role depending on where on the response scale the response is selected. Among the major causes of response scale multidimensionality are response styles. In my presentation I will discuss a taxonomy of models for multidimensional response scales based on: (1) the three families of IRT models: difference models, divide-by-total models, and sequential models (IRTree models), the first of which corresponds to the default choice for ordinal factor analysis, and (2) the type of ordinality violations induced by the multidimensionality. Using these multidimensional response scale models it is possible to investigate how much information is available on the target latent variable in the extreme and midpoint response options. Empirical results will be presented from an analysis of big five personality inventory data.

Student discussant: *Chris Hartgerink*
Staff discussant: *Herbert Hoijtink*

Estimating replicability of science by taking statistical significance into account

Robbie van Aert (Tilburg University)

Consider the following common situation in science nowadays: A researcher reads about a (statistically significant) effect in the literature and replicates the original study. As a result, the researcher has two effect size estimates, and his/her key objective is to evaluate effect size based on these two study outcomes. This objective is particularly challenging if, opposed to the original effect size, the replication's effect size is small and not statistically significant. These challenging situations are omnipresent in science. For instance, 63.9% and 31.3% of the replicated studies in the Reproducibility Project Psychology (RPP) and the Experimental Economics Replication Project (EE-RP) were characterized by a statistically significant effect size in the original study and nonsignificant replication effect size.
The RPP and also EE-RP assessed effect size using fixed-effect meta-analysis. However, fixed-effect meta-analysis yields overestimated effect sizes because it does not take into account the statistical significance of the original study. We developed the snapshot Bayesian hybrid meta-analysis method (snapshot hybrid for short) that does take into account the statistical significance of the original study. This method quantifies the amount of evidence in favor of a zero, small, medium, or large underlying true effect size by computing posterior model probabilities. We will explain snapshot hybrid, and show the results of analytically approximating its statistical properties. We will also present results of applying the method to data of the RPP and EE-RP.

Student discussant: *Alexander Savi*
Staff discussant: *Rink Hoekstra*

The psychometrics of stereotype threat

Paulette Flore (Tilburg University)

The theory on stereotype threat is a popular explanation for the gender gap in mathematical test performance in high school and college students, and has been heavily researched by social psychologists. In those studies stereotype threat was either induced or alleviated through experimental manipulations, and subsequently led to a gender gap in math performance or the lack of a gender gap respectively. Whereas the studies on stereotype threat have been numerous, several methodological issues were (often) ignored, like power analysis, the nested structure of the data, random assignment to conditions on an individual level, and tests for measurement invariance. By means of a meta-analysis, two replication efforts and item level analyses we studied the psychometrics of stereotype threat.

Student discussant: *Aniek Sies*
Staff discussant: *Rob Meijer*

Surfing the emotional landscape

Tim Loossens (KU Leuven)

Despite a vast amount of theoretical and empirical research, there is still a large degree of isolation between the study of the neurobiology and the psychology of affect. We propose a neurobiologically inspired computational model to bridge this explanatory gap. The model is based on the emerging collective behavior of pooled populations of stochastic binary neurons, which excite one another within a pool and typically inhibit one another between pools (comparable to the Ising Decision Maker in choice RT). It can naturally account for nonlinear dynamical and non-dynamical features, such as bimodalities, metastable states, and sudden transitions, features which are observed in affective data samples.

Student discussant: *Kirsten Bulteel*
Staff discussant: *Don van Ravenzwaaij*

Estimating cross-source relationships from big data using component- and networks-analysis

Pia Tio (Tilburg University & University of Amsterdam)

Network analysis has successfully been applied to many different types of psychological data, including personality, cognitive performance, and clinical symptoms. While investigating these different areas in single domains is useful, a better understanding of their structure requires an integrated analysis with several domains or sources of information. Investigating such cross-source relationships often requires large data sets containing information about individuals from multiple sources (big data). Such data are becoming more and more commonplace. However, estimating a network using big data is not without its challenges. The dimension of the dataset, often containing more variables than observations, hinders accurate estimation of relations, even when some form of regularisation (e.g. lasso penalty) is used. Reducing the number of variables would be a straightforward way to remove (or at least reduce) this problem, except that we do not yet know which variables are involved in cross-source relationships. An additional challenge is that big data contains data from different sources that inherently may have different characteristics. For example, indicators of cognitive performance are expected to correlate much higher with one another than with indicators of gene expression. Applying network analysis to such data without taking this difference into account again leads to inaccurate estimation of relationships. We propose the Sparse Network and Component (SNAC) model, which combines regularized simultaneous component analysis with the network framework. Here we present the results of a simulation study demonstrating the benefits of SNAC in estimating cross-source relationships from big data.

Student discussant: *Xinru Li*

Staff discussant: *Laura Bringmann*

Properties of Cohen's kappa

Alexandra de Raadt (University of Groningen)

The first one is about how kappa coefficients are affected by missing data. Cohen's kappa coefficient is commonly used for assessing agreement between two nominal classifications of the same group of persons or objects. Three extensions of Cohen's kappa that can handle missing data are studied. Data are considered missing if there is only one rating of a person or object available. It is shown how the values of the kappas are affected by the amount of missing data using simulations.

The second one is about presenting the Pearson correlation instead of kappa coefficients. For example, in the presence of ordinal subscales, weighted kappa is commonly used to assess the degree of agreement between raters. Using a weighting scheme the distances between the categories are defined, but the form of the scheme is subjective. To avoid this subjectivity, we test whether the Pearson correlation is an effective statistic to present inter-rater reliability. In this study we use real data to calculate Cohen's kappa, the linearly kappa, the quadratically kappa, ICC(3,1), Pearson correlation and Spearman correlation. The Pearson correlation is used to examine whether there are correlations between the different statistics.

The third one is about the effect of deleting a bad category. The number of categories used in various classification schemes varies from the minimum number of two to five in many practical applications. If two categories are easily confused, they cause some disagreement and it may be useful to combine them. However, sometimes there is a single category that is confused with several other categories. In this case the category could e.g. be removed from the scale. In this project it is studied how to deal best with a bad category.

The fourth one is about reporting a category kappa instead of an overall value. In reliability and agreement studies researchers usually want to express the agreement between the raters in a single number. However, the patterns of agreement and sources of disagreement are often too complex to be summarized by a single number. In this project it is argued and illustrated with examples that reporting category kappas for the individual categories is much more informative than reporting a single overall value.

Student discussant: *Eva Zijlmans*

Staff discussant: *Marcel van Assen*

Prior predictive modelling in psychology

Wolf Vanpaemel (KU Leuven)

In this talk, I highlight that predictions are being underused in psychology. This is unfortunate, since they serve many important goals, such as quantifying model complexity, assessing model falsifiability, and evaluating models. To be able to unlock the promise of using predictions in psychology, modellers need to embrace informative parameter priors, augment their models with what can be termed a data prior, and overcome their hypochondriacal fear of subjectivity.

Student discussant: *Giulio Flore*
Staff discussant: *Jelte Wicherts*

From heterogeneous insomnia to (more) homogeneous subtypes – results of a latent class cluster analysis

Tessa Blanken (Free University Amsterdam)

Despite the high prevalence and moderate heritability of insomnia, it has proved remarkably difficult to pinpoint consistent characteristics and mechanisms, suggesting unrecognized heterogeneity. We considered the possibility that insomnia comes in different subtypes of pathophysiology that are differentially reflected in traits and other stable characteristics, and not necessarily also in the specificity of sleep complaints, as commonly assumed.

In N=2,224 participants of the Netherlands Sleep Registry that suffer from insomnia we extensively assessed sleep, life history, cognitive affect, and personality traits. We used latent class cluster analysis for a data-driven search for subtypes, and network analysis to quantify differential associations between their characteristics.

The latent class cluster analysis consistently identified five subtypes, or profiles, that show differential patterns across, most notably, personality factors, affect and life history.

Identifying subtypes facilitates a better understanding of the heterogeneous character of insomnia, which may (i) result in better classification of people with insomnia; (ii) benefit research on underlying mechanisms; and (iii) ultimately improve our ability to optimally tailor personalized treatments.

A dynamic network approach to affective family interactions

Nadja Bodner (KU Leuven)

Family processes have been identified as a key factor of successful adjustment in middle childhood and adolescence. In this study, we explored how affective behaviors differ between families with a depressed adolescent and families with a non-depressed one. During a problem solving interaction, mother's, father's and adolescent's behavior was coded in second-to-second intervals for the presence and absence of angry, dysphoric and happy affect. In the analyses of the resulting binary time series data, we focused on three features of the interaction pattern: frequencies of different affects, concurrent expressions of affect, and the temporal sequencing of affective behaviors. To this end, we computed Jaccard similarity indices on the simultaneous and on the lagged data and visualized the obtained values in networks.

A permutation based test for detecting outlying variables in simultaneous component analysis

Sopiko Gvaladze (KU Leuven)

When closely examining the component structure of multiple variables in different groups of participants, it often happens that the structures strongly resemble each other, but differ for a few variables. Detecting those outlying variables is of great interest as it may reveal interesting group differences. Moreover, having an identical component structure is a prerequisite for further comparisons (i.e., in the measurement invariance framework). To trace outlying variables, De Roover et al. (2014, in press) proposed to combine clusterwise simultaneous component analysis with a detection heuristic based on the Tucker congruence coefficient. However, this heuristic yields many false positives in difficult settings and it is not clear how high the Tucker congruence coefficient should be when no outlying variables are present. As a way out, in this presentation we propose to combine clusterwise SCA with a permutation based significance test. The behavior of both proposals is studied in a simulation study.

A network approach to psychosis

Adela Isvoranu (University of Amsterdam)

In recent years, network models in the fields of psychopathology and psychiatry have gained considerable attention and recognition. In such network models, psychological processes are conceptualized as complex systems in which observable psychological behavior, such as the critical transition to a psychotic episode, is assumed to arise from interactions between symptoms and other psychological, biological, and sociological agents rather than reflective of an unobserved disorder.

Here we used such network models (Borsboom & Cramer, 2013) to investigate how different types of traumatic childhood experiences relate to specific symptoms of psychotic disorders and to identify pathways that may be involved in the relationship between CT and psychosis. We used data of patients diagnosed with a psychotic disorder (n = 552) from the longitudinal observational study Genetic Risk and Outcome of Psychosis Project (Korver et al., 2012) and included the five scales of the Childhood Trauma Questionnaire-Short Form and all original symptom dimensions of the Positive and Negative Syndrome Scale. Our results show that all five types of CT and positive and negative symptoms of psychosis are connected through symptoms of general psychopathology. These findings are in line with the theory of an affective pathway to psychosis after exposure to CT, with anxiety as a main connective component, but they also point to several additional connective paths between trauma and psychosis: e.g., through poor impulse control (connecting abuse to grandiosity, excitement, and hostility) and motor retardation (connecting neglect to most negative symptoms). Overall, these findings suggest that several symptoms of general psychopathology may mediate the relationship between trauma and psychosis, providing evidence for multiple paths between trauma and psychosis. In addition, they re-emphasize the idea that CT is connected to a wide array of symptoms that are present in several mental conditions, and thus are not only specific to psychotic symptoms.

Statistical modelling of energy saving measures

Maliheh Namazkhan (University of Groningen)

To reduce households' energy consumption, using cost-effective energy saving measures such as insulation, solar panels and heat recovery systems will be beneficial for consumers, the energy industry and the environment. Such a reduction in dependency to fossil energy consumption requires household behavioural change. Inducing the necessary changes in household behaviours, not only requires a precise understanding of the energy consumption patterns of households but also a deep insight on house characteristics, household demographics, psychological variables, such as attitudes and beliefs of inhabitants, as well as external factors influencing energy consumption such as the weather, energy prices, inflation, etc. The objective of this project is to enabling industry to offer consumers guaranteed savings and to assists consumers in making informed decisions on investing in energy saving measures given their demographic and psychological characteristics. Mathematical-statistical model(s) incorporating a comprehensive list of variables will be developed to determine the probability distribution of the expected energy savings due to implementation of energy saving measures. The modelling framework will use several existing statistical, psychometric and econometric techniques such as regression, correlation, quality control and discriminant analysis as well as techniques from machine learning. The model(s) will be used to predict gas and/or electricity consumption of existing homes after a proposed energy saving measure, based on a wide range of relevant variables. The model will also be used in determining a minimum guaranteed saving. For households contemplating such an investment, this is important information. In our project, we use data on household characteristics and daily energy consumption patterns from the Dutch and possibly other European households that will be gathered through a survey and by our industrial partners respectively. The model will be developed, calibrated and tested on data from about 15 thousand participating households. Expected results will provide information on the projected short and long-run financial and energy savings due to various energy saving measures, taking into account potential behaviour changes of the households. Implications for the society as a whole, from the effectiveness of various measures in reducing fossil energy consumption and lower energy prices will be analyzed and reported. Furthermore, we will investigate which psychological variables are key influencers in energy consumption.

Exhibition of Shiny apps developed for the TquanT project

Don van den Bergh, Eline Van Geert, Anna Schnell
(University of Amsterdam & KU Leuven)

TquanT stands for "*Tools for Quantitative Thinking*" and it is collaborative project of 13 European universities (among which the University of Amsterdam and KU Leuven). The project is aimed at improving quantitative thinking of students and adult learners. To achieve this, the partners have committed themselves to develop and exchange interactive software with tasks and exercises for teaching quantitative thinking. Here we will show some of the output achieved during the first year of TquanT. TquanT is funded by the Erasmus+ Program of The European Commission.

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