The Department of Educational Psychology's Research Methods, Measurement, & Evaluation (RMME) program and the Department of Statistics at the University of Connecticut present:

Bayesian Covariance Structure Modeling: An Overview and New Developments

Dr. Jean-Paul Fox, University of Twente

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There is large family of statistical models to understand clustered or hierarchical structures in the data (e.g., multilevel models, mixed effect models, random effect models). The general modeling technique is to use a latent variable (i.e., random effect, frailty parameter) to describe the covariance among clustered observations, where the strength of the covariance is represented by the latent variable variance. This approach has several disadvantages. It is only possible to describe positive within-cluster correlation (similarity), and not dissimilarity (Nielsen et al., 2021). Sample size restriction and model complexity are often implied by the number and type of latent variables. Furthermore, the latent variable variance is restricted to be positive, which leads to boundary issues at/around zero and statistical issues in evaluating data in support of a latent variable. A new approach for modeling clustered data is Bayesian covariance structure modeling (BCSM) in which the dependence structure is directly modeled through a structured covariance matrix. BCSM have been developed for various applications and complex dependence structures (Fox et al., 2017, Klotzke and Fox, 2019a, 2019b; Mulder and Fox, 2019). This presentation gives an overview of BCSM and discusses several applications/new developments: (1) BCSM for measurement invariance testing (Fox et al., 2020); (2) BCSM for identifying negative within-cluster correlation and personalized (treatment) effects in counseling; and (3) BCSM for interval-censored, clustered, event-time data from a three-armed randomized clinical trial investigating coronary intervention. This talk discusses prior specification, the multiple-hypothesis-testing problem, and computational demands.

Dr. Jean-Paul Fox is a well-established researcher in the area of Bayesian response modeling. His early work concerns complex psychometric models, for which he received, in 2004 and 2007, a personal grant (an innovational research incentives scheme) from the Netherlands Organisation for Scientific Research (NWO). In 2010, he published a monograph entitled, "Bayesian Item Response Modeling," covering research in statistics and psychometrics. He has published about 70 refereed journal articles. His more-recent work is about Bayesian covariance structure modeling to improve the modeling of process data in educational measurement and to identify personalized treatment effects. Fox also developed and programmed advanced computational statistical estimation methods to support the application of Bayesian response models for complex data. The software has been published in different repositories, in the *Journal of Statistical Software*, and on his website (www.jean-paulfox.com). Several of his publications have described innovative estimation methods and new computational techniques to improve data interpretations. He works at the University of Twente (The Netherlands), where he was appointed Associate Professor in 2007.

ONLINE INTERDISCIPLINARY SEMINARS ON STATISTICAL METHODOLOGY FOR SOCIAL AND BEHAVIORAL RESEARCH: Support for this seminar comes from Department of Educational Psychology's Research Methods, Measurement, & Evaluation (RMME) program and the Department of Statistics at the University of Connecticut (UCONN), the Statistical and Applied Mathematical Sciences Institute (SAMSI), and the New England Statistical Society (NESS). This seminar aims to promote connection between the statistics and social/behavioral science communities and encourage interdisciplinary research across faculty and students. For announcements and WebEx live streaming links, please contact Tracy Burke (tracy.burke@uconn.edu). For questions related to the seminars, please feel free to contact the session organizers, Prof. Xiaojing Wang (xiaojing.wang@uconn.edu) and/or Prof. Betsy McCoach (betsy.mccoach@uconn.edu). For information about previous and upcoming speakers, please visit https://stat.uconn.edu/online-seminars/ or https://rmme.education.uconn.edu/.

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