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8<sup>th</sup> annual Modern Modeling Methods Conference  
May 21<sup>st</sup> – 24<sup>th</sup>, 2018  
University of Connecticut

# *2018 Modern Modeling Methods Conference*

# UCONN

NEAG SCHOOL OF EDUCATION

Welcome and thank you for joining us for the 8<sup>th</sup> annual Modern Modeling Methods Conference at the University of Connecticut. Special thanks to all of the keynote speakers and concurrent presenters for making this wonderful program possible! I look forward to this week all year long. I love seeing all the wonderful modeling work that researchers are doing, and I love getting the chance to interact with people whose work I am reading and citing throughout the year. I am extremely excited to welcome Drs. Susan Murphy, Peter Molenaar, and Tenko Raykov as this year's keynote speakers. Thank you to the following people for their contributions to the conference: Lisa Rasicot, Robbin Haboian-Demircan, Kevin Agnello, and conference services for providing administrative and logistical support for the conference. I couldn't keep this conference going without them!

I hope to see you all again at our ninth annual Modern Modeling Methods Conference May 20<sup>st</sup> – 23<sup>rd</sup>, 2019. We already have one confirmed keynote speaker for 2019: Dr. Bengt Muthén (UCLA), and he will also be conducting an Mplus workshop as either a pre or post conference offering. We are in the process of lining up keynote speakers and another workshop, and we hope to announce those presenters soon. Proposals for concurrent sessions will be due February 1<sup>st</sup>, 2019 and can be submitted online at our website: [www.modeling.uconn.edu](http://www.modeling.uconn.edu)

If you have suggestions, please be sure to fill out the conference evaluation, located on our website, [www.modeling.uconn.edu](http://www.modeling.uconn.edu) . We hope you have a great conference – Happy modeling!

D. Betsy McCoach

Professor, Research Methods, Measurement, and Evaluation program

Department of Educational Psychology, Neag School of Education

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## Modern Modeling Models – 2018 Schedule

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Monday, May 21:  
Preconference workshop

***Just in Time Adaptive Interventions***

Susan A. Murphy and Daniel Almirall

***Continental Breakfast and Registration***

8:00 am – 9:00 am

Laurel Hall Atrium

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*Pre – Conference Workshop*

**Just in Time Adaptive Interventions**

Susan A. Murphy and Daniel Almirall

Laurel Hall 102

9:00 am – 5:00pm

Mobile devices along with wearable sensors facilitate our ability to deliver supportive treatments anytime and anywhere. Indeed, mobile interventions are being developed and employed across a variety of health fields, including to support HIV medication adherence, encourage physical activity and healthier eating as well as to support recovery in addictions. Just-in-time adaptive interventions are mobile health interventions that include notifications or other types of pushes to the user. This workshop will discuss the components of just-in-time adaptive interventions with an eye towards how we might use data to inform the development of these components. We will discuss the design of micro-randomized trial for providing useful data. Lastly a critical question in the optimization of mobile health interventions is: “When and in which contexts, is it most useful to deliver treatments to the user?” This question concerns time-varying dynamic moderation by the context (location, stress, time of day, mood, ambient noise, etc.) of the effectiveness of the treatments on user behavior. We will review and discuss methods for using micro-randomized trial data to assess moderation. Throughout we will illustrate the concepts using trials in a variety of domains including trials aimed at improving engagement in mobile health interventions, in smoking cessation and in physical activity.

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Lunch for the pre-conference workshop is in the Laurel Hall atrium.

**Afternoon break:** Refreshments in Laurel Hall Atrium

# Tuesday – May 22

## *Continental Breakfast and Registration*

7:30 am – 8:30 am

Laurel Hall Atrium

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## *Welcome*

8:30 am

Laurel Hall 102

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## *Opening Keynote-* Susan Murphy

8:35 am – 10:15 am

Laurel Hall 102

## **Stratified Micro-Randomized Trials with Applications in Mobile Health**

Susan Murphy

Harvard University

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Technological advancements in the field of mobile devices and wearable sensors make it possible to deliver treatments anytime and anywhere to users like you and me. Increasingly the delivery of these treatments is triggered by detections/predictions of vulnerability and receptivity. These observations are likely to have been impacted by prior treatments. Furthermore, the treatments are often designed to have an impact on users over a span of time during which subsequent treatments may be provided. Here we discuss our work on the design of a mobile health smoking cessation study in which the above two challenges arose. This work involves the use of multiple online data analysis algorithms. For example, online algorithms are used in the detection of physiological stress. Other algorithms are used to forecast at each vulnerable time, the remaining number of vulnerable times in the day. These algorithms are then inputs into a randomization algorithm that ensures that each user is randomized to each treatment an appropriate number of times per day. We develop the stratified micro-randomized trial which involves not only the randomization algorithm but a precise statement of the meaning of the treatment effects and the primary scientific hypotheses along with primary analyses and sample size calculations. Considerations of causal inference and potential causal bias incurred by inappropriate data analyses play a large role throughout.

## Concurrent paper session 1

Tuesday 10:30 am - 12:00 pm

### Session 1A: Room 202- Bayesian Models

Paper	Authors
<i>Understanding Bayesian Nonparametric Methods Through Programming a Dirichlet Process Mixture Model</i>	Yuelin Li Elizabeth A. Schofield
<i>Bayesian Estimation for Cases of Empirical Underidentification: Examples of Multitrait-Multimethod Data Analysis</i>	Jonathan Helm

### Session 1B: Room 205- Approaches for Modeling Clustered Count Data

Paper	Authors
<i>Approaches for Modeling Clustered Count Data</i>	Ann O'Connell Jing Zhang

### Session 1C: Room 206- Applications of Modeling to Behavioral Research

Paper	Authors
<i>Gender differences in time varying effects of adolescent affect and suicidal ideation following discharge from psychiatric hospitalization</i>	Leslie A. Brick Marisa E. Marraccini Michael F. Arney Nicole R. Nugent
<i>The dilemma of modeling the life course</i>	Y. (Sapphire) Han A.C. (Aart) Liefbroer C.H. (Cees) Elzinga
<i>Transitions in Substance Use Patterns from Adolescence to Young Adulthood</i>	Gabriel J. Merrin Kara Thompson Bonnie J. Leadbeater

### Session 1D: Room 301 Symposium on Statistical Innovations for Longitudinal Data Analysis

Symposium	Authors
<i>Sparse functional log-contrast regression with longitudinal/functional compositional covariates</i>	Kun Chen
<i>Heavy-tailed longitudinal regression models for censored data: A robust parametric approach</i>	Larissa A. Matos Vactor H. Lachos Tsung-I Lin Luis M. Castro
<i>Joint Principal Trend Analysis for Longitudinal High-dimensional Data</i>	Yuping Zhang Zhengqing Ouyang

**Session 1E: Room 302 Symposium on Quantitative Methods for Neuroimaging**

<b>Symposium</b>	<b>Authors</b>
<i>Leveraging a Between-Person Grouping Algorithm to Estimate Within-Person Brain Dynamics</i>	Adriene M. Beltz Hailey L. Dotterer
<i>Evaluating task-dependent brain connectivity with basis functions in GIMME</i>	Kelly A. Duffy Kathleen M. Gates Jessica R. Cohen
<i>Identifying and estimating relations within and between functional brain networks using MIIVsem and GIMME</i>	Kathleen M. Gates Zachary Fisher Kenneth A. Bollen
<i>Confirmatory Subgrouping of Functional Brain Networks in Children with ADHD</i>	Jessica R. Cohen Kelly A. Duffy Stewart H. Mostofsky
<i>Inference Equifinality: Localizing network models using the jackknife.</i>	Teague R. Henry Jessica R. Cohen

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***Lunch*****Tuesday 12:00 pm – 1:00 pm**Student Union Ballroom  
3<sup>rd</sup> floor, Student Union

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**Concurrent paper session 2****Tuesday 1:15 pm – 2:15 pm****Session 2A: Room 202- Bias Reduction Methods**

<b>Paper</b>	<b>Authors</b>
<i>Toward Understanding Contradictory Methods for Reducing Selection Bias in Longitudinal Analyses</i>	Hua Lin Robert E. Larzelere
<i>Assessing Omitted Confounder Bias in Multilevel Mediation Models</i>	Ken Kelley

**Session 2B: Room 205- Modeling Data Dependencies: Theory and Application**

<b>Paper</b>	<b>Authors</b>
<i>Risk ratios for contagious outcomes</i>	Olga Morozova Ted Cohen Forrest W. Crawford
<i>Application of mixed-effect location scale model in a two-group RCT to reveal positive mean changes and decreased dispersion of abstinence attitudes in a longitudinal middle school program.</i>	Harry Piotrowski Donald Hedeker

**Session 2C: Room 206- Advances in Latent Variable Modeling**

<b>Paper</b>	<b>Authors</b>
<i>Evaluation of Case Diagnostics in Latent Variable Modeling</i>	Jennifer Koran Fathima Jaffari
<i>Leverage-based confidence intervals for structural equation modelling.</i>	Paul Dudgeon Mariska Barendse Yves Rosseel

**Session 2D: Room 301- Psychometrics Models**

<b>Paper</b>	<b>Authors</b>
<i>How to model latent ability levels when the correct answer is unknown: a cognitive psychometric approach</i>	Zita Oravecz
<i>A Comparison of Scoring Methods for Multiple-Choice Multiple-Select Items Using NAEP 2016 DBA data</i>	Xiaying Zheng Young Yee Kim

**Session 2E: Room 302- Modeling Applications in Meta-Analysis**

<b>Paper</b>	<b>Authors</b>
<i>Individual participant data meta-analysis with a causal interpretation: Application in adolescent HIV prevention</i>	David H. Barker Heather McGee Daniel Gittins Stone
<i>A Bayesian Network Meta-Analysis of the Relationship between Corruption and Educational Outcomes in the New Millennium</i>	Dandan Chen



## Concurrent paper session 3

Tuesday 2:30 pm – 3:30 pm

### Session 3A: Room 202- Categorical Latent Variable Models

Paper	Authors
<i>Performance of Latent Growth Curve Models with Binary Variables</i>	Jason T. Newsom Nicholas A. Smith
<i>Multilevel SEM for Ordinal Data in the 'Wide' Format Approach</i>	Mariska Barendse Yves Rosseel

### Session 3B: Room 205- Text Analysis Models

Paper	Authors
<i>Waste Not, Want Not: A Methodological Illustration of Quantitative Text Analysis</i>	Laura Castro-Schilo Steven A. Miller
<i>Using Text Mining to Identify Themes in Focus Group Data</i>	Holmes Finch Maria Hernandez Finch Jill Walls Scott Hall

### Session 3C: Room 206- Centering Predictor and Mediator Variable in Multilevel and Time-Series Models with Random Slopes

Paper	Authors
<i>Centering Predictor and Mediator Variable in Multilevel and Time-Series Models with Random Slopes</i>	Tihomir Asparouhov Bengt Muthen

### Session 3D: Room 301- Missing Data

Paper	Authors
<i>Handling Missing Data in Social Network Analysis: A Comparison of Approaches</i>	Nathan T. Abe Elizabeth A. Sanders Elizabeth A. Dietrich

**3:30-3:45 Break-** Refreshments in the Laurel Hall Atrium

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***Keynote- Peter Molenaar***

**Tuesday 3:45-5:00pm**

***Alternative Forms of Granger Causality, Heterogeneity***

*Peter Molenaar*

Laurel Hall 102

3:45 pm – 5:00 pm

Alternative forms of Granger causality based on standard vector autoregressive (VAR), structural VAR and unified structural equation models are presented, including time-frequency domain extensions. The group iterative multiple model estimation (GIMME) approach is proposed as the best method to accommodate heterogeneity and avoid limitations of structural VAR modeling. A new type of VAR – hybrid VAR – is introduced to obtain a unique data-driven solution to Granger causality testing.

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***Poster session and Reception***

Student Union Ballroom

5:00 pm – 6:30 pm

Tuesday, May 22

Third Floor, Student Union

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Please join us for appetizers, an open bar, and 39 fascinating posters on a wide variety of modeling topics. Poster abstracts and presenters are listed in the back of the program, starting on page 44.

## Wednesday – May 23

### *Continental breakfast*

7:30 am – 8:00 am

Laurel Hall Atrium

### ***Concurrent paper session 4***

**Wednesday 8:00 am – 9:00 am**

#### **Session 4A: Room 301- Modeling Theory and Applications**

<b>Paper</b>	<b>Authors</b>
<i>Revisiting Model Selection from Fisher's Scientific Paradigm: An argument against the dichotomization of evidence.</i>	Allen G. Harbaugh Wenbin Teng
<i>Dimensionality of Force Concept Inventory: The Comparison of Bayesian Item Response Models</i>	Xiaowen Liu Eric Loken

#### **Session 4B: Room 305- Reproducing ANOVA Using SEM**

<b>Paper</b>	<b>Authors</b>
<i>Dust Yourself Off and Try Anew: Reproducing ANOVA using SEM</i>	Jonathan Helm

#### **Session 4C: Room 306- Measurement Invariance Applications**

<b>Paper</b>	<b>Authors</b>
<i>Factorial Structure of Attitudes and Social Norms Scales in Math: Testing Measurement Invariance Across Cultural Groups</i>	Sounghwa Walker Keith Widaman
<i>Examining the Factor Structure and Measurement Invariance of Science Attitude Items across Genders</i>	Ji Yoon Jung Anne Traynor

## Concurrent paper session 5

Wednesday 9:15 am – 10:15 am

### Session 5A: Room 301- Exploratory Data Analysis

Paper	Presenter
<i>Comparison of exploratory data mining approaches for understanding adolescent recovery capital</i>	Emily A. Hennessy Emily E. Tanner-Smith Andrew J. Finch
<i>Exploratory Mediation Analysis with Many Mediators</i>	Erik-Jan van Kesteren Daniel Oberski

### Session 5B: Room 106- Latent Class Tree Models

Paper	Authors
<i>Using Latent Class Trees to Classify New Students in an Adaptive Assessment Progression</i>	John P. Madura
<i>An improved latent class (LC) paradigm to obtain meaningful segments in the presence of scale confounds: Scale Adjusted Latent Class (SALC) Tree modeling</i>	Jay Magidson

### Session 5C: Room 305- Modeling Single Case Designs

Paper	Authors
<i>Analysis of Single-Case Experimental Count Data Using the Linear Mixed Effects Model: A Simulation Study</i>	Lies Declercq Laleh Jamshidi S. Natasha Beretvas Mariola Moeyaert John M. Ferron Wilm Van den Noortgate Belen Fernandez-Castilla
<i>Synthesizing Single-Case Studies via Multilevel Models: Limitation of Model Complexity</i>	Ke Cheng Zhiyao Yi John Ferron Mariola Moeyaert S. Natasha Beretvas Wilm Van den Noortgate

### Session 5D: Room 306- Latent Variable Modeling

Paper	Authors
<i>Estimation and Application of the Latent Group Model</i>	Joseph Bonito Jennifer L. Ervin Sarah M. Staggs
<i>Quantifying estimation uncertainty by examination of fungible parameter estimates in SEM</i>	Jordan L. Prendez Jeffrey R. Harring

**Concurrent paper session 6****Wednesday 10:30am – 12:00 pm****Session 6A: Room 106- Educational and Social Applications**

<b>Paper</b>	<b>Authors</b>
<i>School performance and environmental factors among students in Kenya context: Dealing with endogeneity</i>	Mwarumba Mwavita Simon Wagura
<i>Getting a Clear Picture of Kindergarten Learning and Performance</i>	Ya Mo Nell Sedransk

**Session 6B: Room 107- Symposium – Substance Use Focused Mediation Modeling**

<b>Symposium</b>	<b>Authors</b>
<i>The Factor Structure of Self-Esteem and Its Relationship to Alcohol Use in American Indian Adolescents</i>	Melissa R. Schick Tessa Nalve Natasha Prasad Nichea S. Spillane
<i>How do text-messaging smoking cessation interventions confer benefit? A multiple mediation analysis of Text2Quit.</i>	Bettina B. Hoeppepner Susanne S. Hoeppepner Lorien C. Abrams
<i>Early onset marijuana use is associated with learning inefficiencies</i>	Randi M. Schuster Susanne S. Hoeppepner Anne E. Evins Jodi M. Gilman
<i>A reinforcement sensitivity model of affective and behavioral dysregulation in marijuana use and associated problems</i>	Noah N. Emery Jeffrey S. Simons

**Session 6C: Room 301- Mixture Modeling Applications**

<b>Paper</b>	<b>Authors</b>
<i>Modeling of Self-Report Behavior Data using the Generalized Covariates in a Uniform and Shifted Binomial Mixture Model</i>	Holmes Finch Maria Hernandez Finch
<i>Cluster Effects on Parameter Estimation in Multilevel Regression Mixture Models</i>	Chi Chang M Lee Van Horn

**Session 6D: Room 305- Bayesian Thinking**

<b>Paper</b>	<b>Authors</b>
<i>Operationalizations of inaccuracy of prior distributions in simulation studies: implications for recommendations made for applied researchers</i>	Milica Miocevic
<i>Towards Bayesian Small-Sample Variance Components: a Gentle Introduction for the Newcomer</i>	Jonathan Templin Tyler Hicks Lesa Hoffman

**Session 6E: Room 306- Symposium – Recent Advanced in Online-Updating Methods for Regression-type Models Involving Big Data Streams**

<b>Symposium</b>	<b>Authors</b>
<i>Online Updating of Statistical Inference in the Big Data Setting</i>	Elizabeth D. Schifano
<i>Online Updating of Survival Analysis in the Big Data Setting</i>	Jing Wu
<i>Proportional Hazards Tests and Diagnostics in the Online Updating Setting</i>	Yishu Xue

**Lunch****Wednesday 12:00 pm – 1:00 pm**

Student Union

*The card in your packet has \$13.00 that can be used at any of the Student Union eateries EXCEPT Subway.*

## Concurrent paper session 7

Wednesday 1:15 pm – 2:15 pm

### Session 7A: Room 106- Modeling Applications

Paper	Authors
<i>The longitudinal associations between substance use, crime, and social risk among emerging adults: A longitudinal within and between-person latent variables analysis</i>	Gabriel J. Merrin Jordan P. Davis Daniel Berry Elizabeth D'Amico Tara M. Dumas

### Session 7B: Room 301- Modeling Health Disparities

Paper	Authors
<i>Modeling health disparities with a unique combinations of 1-on-1 matching and latent difference and latent change scores</i>	Emil Coman Christina Wilson Alyse Melville Judith Fifield
<i>A methodical review of the causal role of socioeconomic determinants of health disparities</i>	Emil Coman Shervin Assari Helen Z. Wu

### Session 7C: Room 305- Symposium – Advances in Handling Complex Nested Data Structures in Multivariate Multilevel Models

Symposium	Presenter
<i>A New Way for Handling Student Mobility with Longitudinal Data in Educational Research</i>	Congying Sun Audrey Leroux Christopher Cappelli
<i>Evaluation of a Piecewise Growth Model for Multiple Membership Data Structures</i>	Christopher Cappelli Audrey Leroux David Fikis
<i>Multilevel Latent Class Analysis for Cross-Classified Data Structures</i>	Katherine Masyn Audrey Leroux

### Session 7D: Room 306- Sensitivity Analysis in Latent Growth Curve Mediation Models

Paper	Authors
<i>Sensitivity Analysis in Latent Growth Curve Mediation Models</i>	Davwood Tofighi Yu-Yu Hsiao Eric S. Kruger David P. MacKinnon M. Lee Van Horn Katie Witkiewitz

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***Keynote- Tenko Raykov***

**Wednesday 2:30-4:00pm**

***Item Response Theory and Classical Test Theory: Too Long Too Far  
Tenko Raykov***

Laurel Hall 102

2:30 pm – 4:00 pm

This talk presents a view of item response theory that is inclusive of classical test theory rather than juxtaposing the former to the latter. In the widely employed setting in empirical research of homogeneous binary or binary scored items with no guessing, popular item response theory models can be directly obtained from appropriately developed classical test theory-based models accounting for the discrete nature of the observed items. Two distinct (observational) equivalency approaches are pointed out that render these item response theory models from corresponding classical test theory-based models and can each be used to obtain the former from the latter models. Similarly, classical test theory-based models can be furnished utilizing the reverse application of either of those approaches from corresponding item response theory models.

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Thursday, May 24  
Post-conference workshop  
9:00am-5:00  
Laurel Hall 102

***Item Response Theory from a Latent Variable Modeling Framework***

Tenko Raykov

***Continental Breakfast***

8:30 am – 9:00 am

Laurel Hall Atrium

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Post – Conference Workshop

***Item Response Theory from a Latent Variable Modeling Framework***

**Tenko Raykov**

This workshop presents a latent variable modeling approach to item response theory (IRT) and item response modeling (IRM). The workshop commences with a non-traditional approach to IRT and IRM that is based on their essential connections to other behavioral measurement methodologies. These include classical test theory (CTT), (nonlinear) factor analysis, and logistic regression. The flaws of earlier treatments of CTT in the context of multiple IRT and IRM discussions are pointed out, which in addition to misrepresenting CTT effectively shift away research attention to more specific rather than more generally applicable modeling and analytic procedures. Recent research on the connections between classical test theory and IRT/IRM is then reviewed. Using a measurement invariance examination based approach, a multiple testing method for differential item functioning is discussed that deals with limitations of an existing widely utilized procedure. A readily applicable method for studying essential unidimensionality of multi-item measuring instruments is then obtained as a byproduct of this method. Item response models with covariates are finally discussed. Use of the popular software Mplus and Stata is made repeatedly and, on a few occasions, IRTPRO, flexMIRT, and R are utilized. The workshop is based on an integrative approach to measurement in the behavioral and social sciences and emphasizes throughout the links between IRT and IRM on the one hand and other measurement and modeling methodologies related to them on the other hand. All workshop attendees will receive temporary Stata licenses so that they can run the analyses themselves.

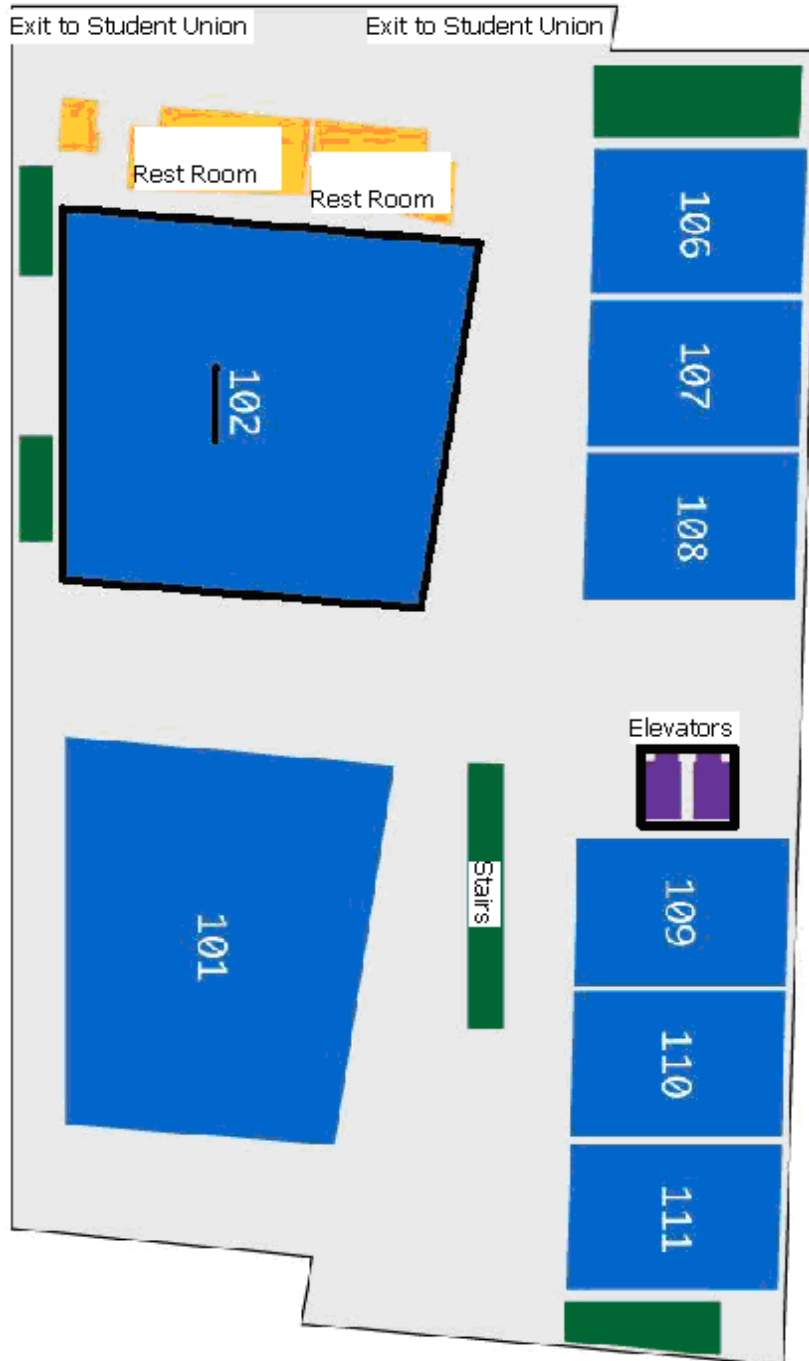
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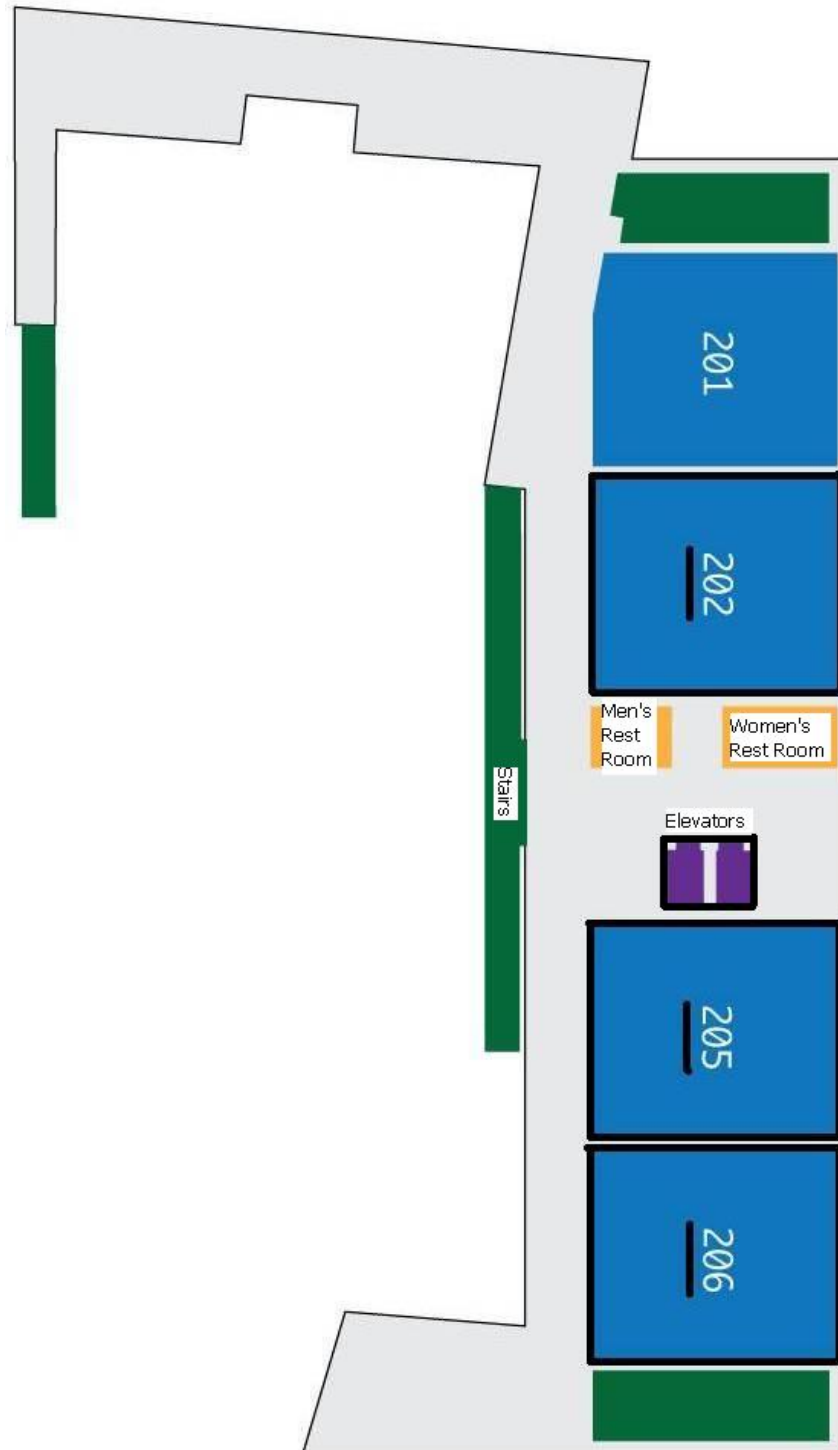
# Maps

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***Laurel Hall (Classroom Building) Floor Plans:  
First Floor:***



***Laurel Hall (Classroom Building) Floor Plans:  
Second Floor:***



**Laurel Hall (Classroom Building) Floor Plans:**  
**Third Floor:**



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# Paper Abstracts

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## Concurrent Paper Session 1: Tuesday 10:30am - 12:00pm

### Session 1A: Bayesian Models

#### **Understanding Bayesian Nonparametric Methods Through Programming a Dirichlet Process Mixture Model**

*Yuelin Li and Elizabeth A. Schofield*

Bayesian Nonparametric (BNP) methods are gaining popularity in recent years in part because they overcome issues in model overfit. For example, a conventional k-means cluster analysis always runs into the issue of what k should be k=2, 3, or 4? BNP clustering addresses this issue directly by allowing new clusters to emerge as necessary. We present a how-to guide on the Dirichlet Process prior in BNP, using Dirichlet Process Mixture Model (DPMM) as an illustrative example. We aim to demonstrate that: 1) students in a Quantitative Psychology program can teach themselves the basics in BNP and write a program in R to carry it out; and 2) writing the computer program may actually facilitate a deeper understanding of the theory and concepts. We intentionally avoid full-fledged packages (e.g., DPpackage in R, or scikit-learn.sourceforge.net) because they tend to be too technical. We will show that DPMM works better than conventional clustering in identifying cancer patients who respond to psychotherapy. Briefly, psychosocial measures were assessed in a randomized controlled trial (NIH R01 CA128134, PI: Breitbart) comparing three psychotherapies in 321 patients with advanced or terminal cancer. DPMM predicted the post-intervention outcomes better than a comparable analysis using k-means. The goal of this presentation is to make complex DPMM concepts accessible to future methodologists in social and behavioral sciences so they can apply these foundational skills in new methodologies.

#### **Bayesian Estimation for Cases of Empirical Underidentification: Examples of Multitrait-Multimethod Data Analysis**

*Jonathan Helm*

The correlated trait-correlated method model (CT-CM) and the true-score multitrait-multimethod model (TS-MTMM) are two structural equation models that can summarize multitrait-multimethod data. However, these two models often produce inadmissible solutions (e.g., failed convergence, out-of-bounds parameter estimates), which may be due to empirical under-identification (i.e., the data do not contain enough information to produce a unique set of parameter estimates, even though the model may accurately represent the data generation process). This presentation describes how Bayesian estimation can alleviate these estimation problems. A large-scale simulation showed that Bayesian estimation produced admissible solutions for 99.99% of data sets simulated from the CT-CM and TS-MTMM, whereas ML only produced admissible solutions for 49.82% and 36.48% of data sets simulated from CT-CM and TS-MTMM, respectively. Furthermore, Bayesian parameter estimates showed comparable bias and greater efficiency relative to ML parameter estimates. The results of the simulation were echoed by five empirical examples, which lead to admissible parameter solutions for Bayesian estimation and inadmissible solutions for ML. The presentation concludes with a discussion of how the Bayesian estimation procedure aids parameter estimation for different sources of empirical under-identification, and why Bayesian estimation should help assuage estimation difficulties for other models used in psychological science.

## **Session 1B: Approaches for Modeling Clustered Count Data**

*Ann O'Connell and Jing Zhang*

In this presentation, we review some of the methodological challenges of working with count outcomes in general, beginning with common models for single-level count data from Poisson through the Negative Binomial. We then discuss extensions for more complex samples and present some applied examples for count models when data are clustered or hierarchical. We use SAS, HLM, and Mplus software to illustrate these models using data from a medical intervention trial and an education setting, highlighting differences between unit-specific and population-averaged models, including the use of generalized estimating equations (GEE), and considerations on when to use different approaches.

## **Session 1C: Behavioral Applications**

### **Gender differences in time varying effects of adolescent affect and suicidal ideation following discharge from psychiatric hospitalization**

*Leslie A. Brick, Marisa E. Marraccini, Michael F. Arney, and Nicole R. Nugent*

The acute period following discharge from hospitalization due to suicidal thoughts or behaviors (STB) represents a period of marked risk for suicide, with recent estimates of the suicide rate for patients hospitalized with STB to be 200 times the global suicide rate. In the current study, ecological momentary assessment was employed to measure variation in affect and suicidal ideation (SI) among adolescents during the three weeks following discharge from hospitalization for STB. N=108 adolescents aged 13-18 were provided with a mobile phone that signaled several times a day to assess momentary affect and SI. Time varying effects models (TVEM) were used to examine (1) the effect of gender on affect and (2) the time-varying relationship between affect and SI. Results demonstrated that males and females exhibit significant differences in positive, but not negative, affect. For both males and females, positive affect was associated with a decrease in the odds of endorsing SI and negative affect was associated with an increase in the odds of endorsing SI. However, the relationship between affect and SI was not stable over time. Findings from this study help to establish the time-varying relationship between affect and SI that can serve to inform future interventions.

### **The dilemma of modeling the life course**

*Y. (Sapphire) Han, A.C. (Aart) Liefbroer, and C.H. (Cees) Elzinga*

The experience of parental divorce has consequences for a broad range of family behaviors of the children during their young adulthood. Re-searchers have demonstrated the cross-national differences of the effect of parental divorce on aspects such as children's home leaving and marital stability. However, in linking parental background and cross-national context studies, studies that combine life course trajectories from multiple events are scarce. Our previous work demonstrates the application of Hidden Markov Models to uncover the mechanisms of family formation and the role of background variables therein. In this study, we will examine the influence of parental divorce on children's family formation process during their young adulthood and cross-national difference based on the advancement of country Second Demographic Transition and types of welfare state using life course data of respondents from six European countries born between 1961 and 1970.

## **Transitions in Substance Use Patterns from Adolescence to Young Adulthood**

*Gabriel J. Merrin, Kara Thompson, and Bonnie J. Leadbeater*

The current study examined substance use classes including cigarette, alcohol, marijuana, and illicit drug use during adolescence and young adulthood and subsequent transitions among classes.

**Method:** Data were collected biennially from 662 youth across six measurement assessments. We used Latent Class Analysis to identify substance use classes at each of the six waves (cigarette, alcohol, marijuana, and illicit drug use) and then examined transition probabilities from early adolescence (12 - 18) to young adulthood (22 - 28) using Latent Transition Analysis (LTA).

**Results:** At each wave a three-class model fit the data best that included a poly-use class, that had the highest probabilities of use among all substances, a co-use class, that had high probabilities of use of alcohol and marijuana, and an alcohol-dominate class that started with low probabilities of use among all substances, with increasing probabilities of alcohol use. LTA showed that the proportion of youth remaining in the same class between waves was high. The probability of remaining in the poly-use class was the most stable from one wave to the next, followed by the alcohol-dominate class. The stability for the co-use class was less stable during later adolescence. The largest transitions occurred for the co-use class, with individuals transitioning to the poly-use class more than to the alcohol-dominate class. **Conclusions:** Lasting effects of early substance use patterns were evident. Transitions were typically to use more substance, although, recovery was evident for some youth. Distinguishing stable from transitioning patterns of use provides an opportunity for prevention and intervention efforts to disrupt high-risk substance use patterns.

## **Session 1D: Symposium – Statistical Innovations for Longitudinal Data Analysis**

**Chair:** Yuping Zhang

Longitudinal data analysis is an increasingly popular and important. This session will cover several new statistical methods motivated by important scientific problems with diverse types of longitudinal data involved. Examples include longitudinal microbiome data, heavy tailed data, and longitudinal genomics data.

### **Paper 1: Sparse functional log-contrast regression with longitudinal/functional compositional covariates**

*Ken Chen*

### **Paper 2: Heavy-tailed longitudinal regression models for censored data: A robust parametric approaches**

*Larissa A. Matos, Vactor H. Lachos, Tsung-I Lin, and Luis M. Castro*

### **Paper 3: Joint Principal Trend Analysis for Longitudinal High-dimensional Data**

*Yuping Zhang and Zhengqing Ouyang*

## **Session 1E: Symposium – Quantitative Methods for Neuroimaging**

**Chair:** Henry Teague

In recent years, neuroimaging methods have become an increasingly powerful tool for studying the relationship between brain and behavior in vivo. This increase in both the number of neuroimaging studies and the quality of the resulting data makes this field a prime candidate for methodological development, particularly with traditional techniques such as latent variable modeling and mixture modeling. In this symposium we present brief introduction to neuroimaging terminology, followed by a series of five related talks, each discussing a novel methodological innovation applied to neuroimaging data. The first three talks focus on the application of structural equation modeling approaches to functional neuroimaging data, exploring time varying and latent variable modeling strategies. The fourth talk explores multiple groups modeling and introduces a novel analysis strategy, network analysis. The final talk expands on the network analysis strategy applied to neuroimaging data and presents a new method for localizing network results.

**Paper 1: Leveraging a Between-Person Grouping Algorithm to Estimate Within-Person Brain Dynamics**

*Adriene M. Beltz and Hailey L. Dotterer*

**Paper 2: Evaluating task-dependent brain connectivity with basis functions in GIMME**

*Kelly A. Duffy, Kathleen M. Gates, and Jessica R. Cohen*

**Paper 3: Identifying and estimating relations within and between functional brain networks using MIIVsem and GIMME**

*Kathleen M. Gates, Zachary Fisher, and Kenneth A. Bollen*

**Paper 4: Confirmatory Subgrouping of Functional Brain Networks in Children with ADHD**

*Jessica R. Cohen, Kelly A. Duffy, and Stewart H. Mostofsky*

**Paper 5: Inference Equifinality: Localizing network models using the jackknife.**

*Teague R. Henry and Jessica R. Cohen*



## Concurrent Paper Session 2: Tuesday 1:15pm – 2:15pm

### Session 2A: Bias Reduction Methods

#### **Toward Understanding Contradictory Methods for Reducing Selection Bias in Longitudinal Analyses**

*Hua Lin and Robert E. Larzelere*

Minimizing selection bias in nonrandomized longitudinal analyses is necessary to approximate unbiased causal estimates more closely. Two methods of adjusting for pre-test differences on the outcome variable can produce contradictory results, however, as illustrated in Lord (1967) paradox. We document similar contradictory results for the apparent effects of two treatment for depression in mothers, using the Fragile Families longitudinal data. ANCOVA-type adjustments seemed to indicate that both medications and therapy for depression made depressive symptoms worse after controlling for initial scores on depression symptoms. In contrast, predicting simple CHANGE in depression symptoms indicated that both treatments were associated with decreases in those symptoms. To understand these contradictory results, we simulated data to replicate Lords' paradox and data simulated to reverse that paradox. Whereas the original paradox data can be considered as designed to fit the CHANGE null hypothesis, our reversed Lord's paradox uses data simulated to fit the ANCOVA null hypothesis. In both cases the ANCOVA results are biased in the direction of the pretest differences, relative to the CHANGE results. We then varied the simulated data to test three ANCOVA assumptions. The results indicated that Lords' paradox is due to violations of the ANCOVA assumption that treatment conditions should be independent of the pre-test covariate. Lords' paradox did not vary by homogeneity of the within-group slope coefficients. Modifying most of the sample to a replicated outlier score reduced statistical power and the magnitude of Lords' paradox.

#### **Assessing Omitted Confounder Bias in Multilevel Mediation Models**

*Ken Kelley*

To draw valid inference about an indirect effect in a mediation model, there must be no omitted confounders. No omitted confounders means that there are no common causes of hypothesized causal relationships. When the no-omitted-confounder assumption is violated, inference about indirect effects can be severely biased and the results potentially misleading. Despite the increasing attention to address confounder bias in single-level mediation, this topic has received little attention in the growing area of multilevel mediation analysis. A formidable challenge is that the no-omitted-confounder assumption is untestable. To address this challenge, we first analytically examined the biasing effects of potential violations of this critical assumption in a two-level mediation model with random intercepts and slopes, in which all the variables are measured at Level 1. Our analytic results show that omitting a Level 1 confounder can yield misleading results about key quantities of interest, such as Level 1 and Level 2 indirect effects. Second, we proposed a sensitivity analysis technique to assess the extent to which potential violation of the no-omitted-confounder assumption might invalidate or alter the conclusions about the indirect effects observed. We illustrate the methods using an empirical study and provided computer code so that researchers can implement the methods discussed.

## **Session 2B: Modeling Data Dependencies: Theory and Application**

### **Risk ratios for contagious outcomes**

*Olga Morozova, Ted Cohen, and Forrest W. Crawford*

Epidemiologists commonly use the risk ratio to summarize the relationship between a binary covariate and outcome, even when outcomes may be dependent. Investigations of transmissible diseases in clusters -- households, villages, or small groups -- often report risk ratios.

Epidemiologists have warned that risk ratios may be misleading when outcomes are contagious, but the nature of this error is poorly understood. In this study, we assess the meaning of the risk ratio when outcomes are contagious. We provide a mathematical definition of infectious disease transmission within clusters, based on the canonical stochastic susceptible-infective model. From this characterization, we define the individual-level ratio of instantaneous infection risks as the inferential target, and evaluate the properties of the risk ratio as an approximation of this quantity. We exhibit analytically and by simulation the circumstances under which the risk ratio implies an effect whose direction is opposite that of the true effect of the covariate. In particular, the risk ratio can be greater than one even when the covariate reduces both individual-level susceptibility to infection, and transmissibility once infected. We explain these findings in the epidemiologic language of confounding and Simpson's paradox, underscoring the pitfalls of failing to account for transmission when outcomes are contagious.

### **Application of mixed-effect location scale model in a two-group RCT to reveal positive mean changes and decreased dispersion of abstinence attitudes in a longitudinal middle school program.**

*Harry Piotrowski and Donald Hedeker*

Purpose is to present mixed-effects location scale model (MLSM) and results of RCT Positive Potential program mean change and heterogeneity variation in sexual activity abstinence attitudes and development of stable latent trait. Background: Program evaluations are usually fitted to mean differences outcomes assuming constant variance-covariance component using covariates in mixed-effects regressions. We examined the joint modeling of student mean and variance of abstinence attitudes in intervention/control groups longitudinally using MixregLS (1,577 students, 10,224 observations). Methods: A school cluster RCT compared Positive Potential classroom intervention with no-intervention group. Students completed surveys 7 times/waves: before-after grades 6, 7, 8, and grade-9 12-month post (4-item composite, alpha range 0.68-0.76). Study design covariates were two cohorts (2011-2012) and 7 intervention-control school pairs matched by size; student covariates were: girls, 50%, white non-Hispanic, 83.1%; baseline mean age 11. Intervention Group Results: abstinence attitudes mean significantly increased 1.33% per wave, between groups variation decreased in dispersion/heterogeneity 8.5% and, erratic/unstable variability decreased 10.0%. Overall, student level variability increased 14.2% per unit of time, 110.0% higher variability for boys and 25% higher variability per year of age. Discussion: Exploring factors related to intra-individual variability can help to understand observed between- and within-subjects differences and intervention effectiveness beyond mean changes.

## **Session 2C: Advances in Latent Variable Modeling**

### **Evaluation of Case Diagnostics in Latent Variable Modeling**

*Jennifer Koran and Fathima Jaffari*

Case diagnostic statistics have been introduced to identify unusual cases that may unduly influence the results of fitting latent variable models. However, little is known about the performance of these statistics under various conditions. Existing research has generally introduced such statistics and illustrated their application using a single real or simulated data set. This study used statistical simulation to evaluate performance of several case diagnostic statistics under a variety of conditions. Results suggest that the Likelihood Distance and generalized Cook's Distance statistics detect unusual cases more effectively than the delta Chi-square statistic. The Likelihood Distance and generalized Cook's Distance statistics overlooked fewer cases that should have been detected, and their performance was not undermined by mild model misspecification. Researchers applying case diagnostic statistics when fitting latent variable models should be aware that the Likelihood Distance, generalized Cook's Distance, and delta Chi-square statistics had a significantly higher rate of flagging cases that should not have been detected when compared to Mahalanobis Distance.

### **Leverage-based Confidence Intervals for Structural Equation Modeling.**

*Paul Dudgeon, Mariska Barendse, and Yves Rosseel*

Leverage is a measure of how far away one individual's set of scores of 2 or more variables is from the scores of all other individuals. Besides its usage in regression diagnostics, leverage is also used in estimators of the covariance matrix of regression parameters when standard assumptions of homoscedasticity and/or normality are violated---these are called heteroscedastic-consistent (HC) estimators in the literature, and they were originally proposed by Huber in the 1970s and by White in the 1980s. Because linear regression is a particular specification in structural equation modelling (SEM), HC-type estimators are theoretically possible in SEM also. However, an equivalent of original White's HCO estimator is currently only available in SEM, together with Browne's (1984) asymptotically distribution free estimator (see Yuan & Hayashi, 2008, for details of the similarities and differences between these two estimators). Both are often referred to as robust estimators or sandwich estimators in the SEM literature. This presentation develops leverage-based sandwich estimators for deriving standard errors and confidence intervals (CIs) in SEM. These new estimators are analogous to the HC3 estimator used in linear regression. They can be shown to be extensions of the HCO-type and ADF-type estimators currently available in programs such as Mplus and EQS. A detailed Monte Carlo simulation study (in which sample size, multivariate non-normality, model misspecification, and estimators are systematically varied) shows that neither of the two current robust estimators used in SEM are as robust as the appellation given to them implies. More importantly, we show that the incorporation of leverage into current sandwich estimators used in SEM results in much better coverage in CIs, even for sample sizes as low as 50 (where the robustness of the two current estimators both perform badly). Robustness of coverage is appropriately assessed using Serlin (2000) range null hypothesis test and a mixed effects logistic regression meta-model (Skrondal, 2000) of robustness is used to assess main effects and interaction effects in the simulation design.

## **Session 2D: Psychometrics Models**

### **How to model latent ability levels when the correct answer is unknown: a cognitive psychometric approach**

*Zita Oravecz*

In this talk, I will introduce and illustrate a cognitive psychometric model, the Extended Condorcet Model (ECM). The ECM can be fitted to response data in which a set of respondents answer questions that pertain to some shared knowledge domain, with correct answers unknown to the researcher. With the ECM, we can simultaneously estimate the answer key based on consensus among the respondents, the participants ability related to knowing these answers, their propensity to guess when uncertain and item difficulty levels. In the proposed ECM, both person- and item-related parameters are random effects which can be made function of covariates to account for patterns of inter-individual and inter-item variability. I will illustrate the approach with applied examples, including a study on the consensus judgements for the grammatical correctness of English sentences, and another one on what makes people feel loved.

### **A Comparison of Scoring Methods for Multiple-Choice Multiple-Select Items Using NAEP 2016 DBA data**

*Xiaying Zheng and Young Yee Kim*

In 2016, multiple-choice multiple-select (MCMS) items were introduced in National Assessment of Educational Progress (NAEP) Digitally Based Assessments (DBA) as a type of innovative items, which allowed students to choose more than one answer to a question. Compared to traditional multiple choice items, the scoring and modeling of MCMS items have been less explored for large-scale assessments. The goal of the study is to compare three scoring methods for MCMS items using data from the 2016 NAEP DBA grade 8 mathematics pilot assessment, namely NAEP operational scoring, uniform scoring, and option-based scoring. The scored data are then analyzed using item response theory models. The results are compared with respect to parameter estimates, model-data fit, test information, and reliability. The preliminary results demonstrated that the option-based scoring method yielded higher test information for the lower end of the ability distribution. The study highlights the importance of analytic methods for innovative items in large-scale assessments and will provide helpful insights for future MCMS item development and analyses.

## **Session 2E: Modeling Applications in Meta-Analysis**

### **Individual participant data meta-analysis with a causal interpretation: Application in adolescent HIV prevention**

*David H. Barker, Heather McGee, and Daniel Gittins Stone*

Heterogeneity of treatment effects (HTE) limit generalization of causal interpretations from randomized trials to meta-analytic work. Generalization requires assuming a close match between baseline characteristics of trial samples or assuming that between sample differences do not influence treatment response. Extending statistical approaches to causal inference from individual trials to meta-analyses of individual participant data promises to provide a more rigorous exploration of both within and between trial sources of HTE. In this paper, we report results from an application of predictive causal modeling using data from three RCTs of adolescent HIV prevention. We will also discuss challenges, opportunities, and next steps.

### **A Bayesian Network Meta-Analysis of the Relationship between Corruption and Educational Outcomes in the New Millennium**

*Dandan Chen*

There is no meta-analysis or systematic review of the literature on the association between corruption and the education system across countries, not to mention a network analysis. This paper conducts a network meta-analysis (NMA), a new technique recently matured that informs policymaking with considerable attention to both the direct and indirect evidence in all possible comparisons via one single model, via the Bayesian approach. Its research questions address the association between the education system and the level of corruption, listed as follows: 1) To what extent are policymakers' characteristics associated with corruption in education? 2) To what extent are education service providers' characteristics associated with corruption in education? 3) To what extent are education beneficiaries' characteristics associated with corruption in education? This research study fills in the blank in the review of the empirical findings regarding corruption in the education system. The findings from this network meta-analysis echo with the international move against corruption and inform the education policymakers of the important factors they should pay attention to in prevention of corruption in the education system.

## Concurrent Paper Session 3: Tuesday 2:30pm – 3:30pm

### Session 3A: Categorical Latent Variable Models

#### Performance of Latent Growth Curve Models with Binary Variables

*Jason T. Newsom and Nicholas A. Smith*

A Monte Carlo simulation was used to evaluate the performance of binary latent growth curve (LGC) models that compared estimation method (mean and variance adjusted diagonally weighted least squares vs. robust maximum likelihood), effect size of intercept (small proportion vs. medium proportion), effect size of slope (zero vs. medium effect), sample size ( $N = 100, 200, 500, \text{ and } 1000$ ), and the number of time points ( $T = 3, 5, 7$ ). Convergence, parameter and standard error bias, coverage, and Type I error rates were examined. Results indicate that robust maximum likelihood performed better than diagonally weighted least squares in convergence, parameter bias, and standard error bias. Bias decreased with the number of time points and sample size. In general, samples with three time points had unacceptable levels of bias for either estimation method. MLR had acceptable levels of bias for as few as 200 cases in most conditions, and WLSMV generally required a minimum of 500 cases. These findings provide researchers with important guidance about the estimation approach, minimum sample size, and minimum number of time points required to investigate growth with binary indicators.

#### Multilevel SEM for Ordinal Data in the 'Wide' Format Approach

*Mariska Barendse and Yves Rosseel*

For continuous data, Bauer (2003) and Mehta & Neale (2005) among others showed how to model multilevel data, where units at Level 1 are nested in clusters at Level 2, which in turn may be nested in even larger clusters at Level 3, and so on, in a 'wide' or 'multivariate' format approach. Hence, complex balanced and unbalanced multilevel structural equation (SEM) models can be modeled intuitively and easily fitted in single-level SEM programs. In this presentation, we will show how to apply this 'wide' format approach to SEM with ordinal data. Random intercept models can then be fitted in any software program that can handle ordinal data while random slope models can only be modeled by fixing model parameters to individual specific data values. We will discuss the implications for model identification and model estimation. A real data example from educational research will be used to illustrate the approach.

### Session 3B: Text Analysis Models

#### Waste Not, Want Not: A Methodological Illustration of Quantitative Text Analysis

*Laura Castro-Schilo and Steven A. Miller*

One of the most common resources that psychologists collect is text in free-form. This text might come from comments, feedback, and other open-ended text fields in surveys or from transcriptions of interviews, videos, etc. Notably, researchers have used wisely the information conveyed in text for many years. However, in many instances, the qualitative methods employed require numerous hours of reading, training, coding, and validating, among others. As technology continues to evolve, simple access to text data is blooming. For example, researchers conducting online studies can have thousands of text entries from participants' comments. Even without recent advances in technology researchers have had access to text in books, letters, and other archival data for centuries. One important challenge, however, is figuring out how to make sense of text data without investing a large number of resources, time, and the effort involved in qualitative methodology or "old-school" quantitative approaches (such as reading a collection of 200 books and counting the

occurrence of important terms in the text). This challenge has been solved in the information retrieval field branch of computer science with the implementation of a technique called latent semantic analysis (LSA; Manning, Raghavan, & Schatze, 2008) and a closely related technique called topic analysis (TA; SAS Institute Inc., 2018). Undoubtedly, other quantitative methods for text analysis, such as latent Dirichlet analysis (Blei, Ng, & Jordan, 2003), are also apt for the task of unveiling knowledge from text data, but we restrict the discussion in this presentation to LSA and TA because these exclusively deal with the underlying structure of the text rather than identifying clusters. LSA and TA were developed primarily in information retrieval and machine learning research. Thus, the lingo used to describe these techniques and software used to implement them is mostly foreign to those outside these disciplines. In this presentation, we aim to make quantitative text analysis --specifically LSA and TA-- accessible to researchers from a variety of disciplines. We do this by leveraging understanding of multivariate techniques that are very familiar in psychometrics: principal components analysis (PCA) and exploratory factor analysis (EFA). We start by describing LSA and TA by drawing comparisons and equivalencies to PCA and EFA. We make these comparisons in an intuitive, user-friendly manner and then through a technical description of mathematical statements, which rely on the singular value decomposition of a document-term matrix. Moreover, we explain the implementation of LSA and TA using statistical software to enable simple application of these techniques. Finally, we show practical applications of LSA and TA with empirical data. The application of these techniques to psychological text data is rare. Indeed, a few examples of LSA in psychological research (overwhelmingly in cognitive science) have shown this technique to be useful for analyzing couple and family interviews, unscripted conversations of patients with schizophrenia, and social media profiles (Atkins et al., 2012; Babcock, Ta, & Ickes, 2013; Holshausen, Harvey, Elvevag, Foltz, & Bowie, 2014; Kern et al., 2016). Importantly, these examples do not explain in detail how to implement LSA or TA and those who do (e.g., Foltz, 1996) do so with terms that are quite unusual to folks who do not have a background in computer science or linear algebra and use software that is rare, difficult to use, or with little functionality. We attempt to fill this gap in this presentation.

### **Using Text Mining to Identify Themes in Focus Group Data**

*Holmes Finch, Maria Hernandez Finch, Jill Walls, and Scott Hall*

Focus group research is increasingly popular in the social sciences, as researchers attempt to integrate participant perspectives into research findings. However, analysis of focus group transcripts can be time consuming and difficult to code. A potential approach for addressing these difficulties is text mining (TM), which can be used to identify underlying themes and clusters of word use in texts/transcripts, in an objective way. TM, as described in the current study, reflect a variety of statistical tools, including frequency of word use, clustering of words by their use together, clustering of individuals by the patterns of words that they use, and examination of word use by the sentiments expressed. To demonstrate the utility of TM in focus group research, transcripts of multiple focus groups with African-American college students conversing about classroom discussions concerning race are used in this study. Results of the study identified 2 clusters of words, one of which was associated with negative emotions, and the other with diversity. In addition, terms most commonly used in conjunction with the word 'Race' were primarily associated with negative emotions. Implications of the results with regarding use of TM with focus group data will be discussed in the presentation.

### **Session 3C: Centering Predictor and Mediator Variable in Multilevel and Time-Series Models with Random Slopes**

*Tihomir Asparouhov and Bengt Muthen*

We discuss the different methods for centering a predictor or a mediator in multilevel models. We show how the multilevel latent covariate model (i.e. the latent mean centering) can be extended for models with random slopes. Implications are discussed for estimating the multilevel regression models with data missing on the predictors, estimating the contextual effect in multilevel linear and probit regression models, estimating the indirect effect in multilevel mediation models, and estimating random tetrachoric autocorrelations for time-series models with categorical data.

### **Session 3D: Modern Data Modeling Approaches**

#### **Handling Missing Data in Social Network Analysis: A Comparison of Approaches**

*Nathan T. Abe, Elizabeth A. Sanders, and Elizabeth A. Dietrich*

This pilot study contributes to the current gap in educational research methods around various approaches to handling missing data in multiple time-point social network analysis (SNA). Specifically, we focus on what bias, if any, is observed in social network tie formation and persistence parameter estimates using the separable temporal exponential random graph model (STERGM) when the network is small (20 nodes) and has 20% density at time 1 (T1) and 30% density at time 2 (T2). Six levels of missingness amounts were simulated to include 10% or 20% missing at T1, T2, or both. For each level of missingness amount, 1,000 simulated datasets were generated. For each of these, a handful of approaches to handling missing data were used: inserting 0s, inserting 1s, inserting a random mix of 0s and 1s, node deletion, and borrowing auxiliary time point information (from T1 to estimate T2 or vice versa). Preliminary results based on a subsample of simulations (thus far) show that, across both tie formation and persistence estimates, node deletion produced the best unbiased coefficients but the worst biased (inflated) standard errors. For tie formation it appears that using a random mix of 0s and 1s minimized bias in the coefficient and standard error estimation, and that overall, missing data at T2 produced more bias than missingness at T1. On the other hand, when estimating tie persistence, inserting 0s or borrowing from auxiliary information were best at minimizing coefficient and standard error bias, and overall, missing data at T1 produced more bias than missingness at T2.



## Concurrent Paper Session 4: Wednesday 8:00am – 9:00am

### Session 4A: Modeling Theory and Applications

#### **Revisiting Model Selection from Fisher's Scientific Paradigm: An argument against the dichotomization of evidence.**

*Allen G. Harbaugh and Wenbin Teng*

This paper presents a critical examination of the most frequent critique of model selection protocols. Using the basic F-ratio tests for  $R^2$  for multiple regression models (and corresponding protocols using other metrics such as Mallows' Cp), the model selection protocol will be shown to fail to meet the desired standard of evidence evaluation: the strict determination of truth from falsity. However, with the use of simulation research, these protocols will be shown to be exceptionally effective at the discovery of truth from a scientific paradigm that aligns more closely with that proposed by Fisher with the introduction of inferential statistics. More specifically, overall trends of many applications of the protocol to different data sets will demonstrate the ability to ascertain relevant vs. trivial predictors in multiple regression models.

#### **Dimensionality of Force Concept Inventory: The Comparison of Bayesian Item Response Models**

*Xiaowen Liu and Eric Loken*

Force Concept Inventory (FCI) is an instrument for probing conceptual understanding of Newtonian force concepts. It is widely used in undergraduate physics classes as an assessment for common misconceptions. The FCI is an interesting challenge to model because it is deliberately constructed to differ from traditional unidimensional tests. Exploratory factor analysis, Item Response Theory Models, and Item Response Curve have all been used to model responses on the FCI. The current study fit Bayesian item response models in RStan to explore dimensionality of the FCI. We estimated and compared three models: unidimensional two-parameter model, multidimensional two-parameter model, and unidimensional three-parameter model. The two-dimensional model solution appears to provide the best fit. We interpret the dimensions and compare our work to the empirical response curves of Morris et al. and previous IRT analyses of the FCI. Exploring the FCI structure can offer important insights about student understanding for physics instructors who use the inventory to gauge learning and guide instructional practices.

### **Session 4B: Dust Yourself Off and Try Anew: Reproducing ANOVA using SEM**

*Jonathan Helm*

This presentation demonstrates how to reproduce the results (e.g., F-values, p-values) from different kinds of analysis of variance (between subjects, repeated measures, and multivariate ANOVA) using structural equation modeling (SEM). The presented approach differs from prior approaches, which incorporated indicator variables (e.g., dummy variables, effects codes) into a single SEM (analogous to regression). The approach presented here translates the main effects, interaction effects, and distributional assumptions of ANOVA into a set of SEMs with specific equality constraints, and then reproduces the ANOVA by statistically comparing the SEMs (i.e., difference testing). The results are virtually identical (i.e., sample statistics and p-values are equivalent to the third or fourth decimal) across the two approaches for a range of empirical examples, and the models can be extended to relax distributional assumptions (e.g., homogeneity of variance and sphericity) underlying ANOVA. Therefore, this presentation provides researchers with a series of stepping stones for using SEM in place of ANOVA, may facilitate analyses that extend beyond mean differences.

## **Session 4C: Measurement Invariance Applications**

### **Factorial Structure of Attitudes and Social Norms Scales in Math: Testing Measurement Invariance Across Cultural Groups**

*Sounghwa Walker and Keith Widaman*

The purpose of the present study is twofold: (1) to evaluate the factorial structure of a multidimensional representation of math attitudes (Affective, Behavioral, and Cognitive factors) and perceived math social norms (Parent, Peer, and Teacher factors) and (2) to test whether measurement of the six factors would be invariant across national groups (USA, Hong Kong, and Singapore). The sample data ( $N = 15,019$ ) for the current investigation were obtained from the 2012 Programme of International Student Assessment (PISA) database. Alpha coefficients (.73 - .91) and composite reliability scores (.75 - .91) indicated strong internal consistency for each of the six factors. All factor loadings from Confirmatory Factor Analysis (CFA) were also high and statistically significant (standardized loadings ranging from .52 - .90,  $ps < .001$ ). Correlation matrices displayed clear convergent and discriminant validity; the square root of the Average Variance Extracted (AVE) for each factor (.71 - .85) was higher than any of the bivariate correlations of the six factors ( $r = .21 - .51$ ,  $ps < .001$ ), which was additional method used to demonstrate discriminant validity (Fornell & Larcker, 1981). Furthermore, the results of Multigroup Confirmatory Factor Analysis (MGCFA) confirmed that the measurements exhibited invariance or equivalence across national groups at the level of strong factorial invariance (or scalar invariance). Implications and limitations of the present study findings are discussed.

### **Examining the Factor Structure and Measurement Invariance of Science Attitude Items across Genders**

*Ji Yoon Jung and Anne Traynor*

Encouraging students' positive attitudes toward science is a central objective in science education because the promotion of favorable science attitudes has been shown to foster higher attainment. Although the Trends in International Mathematics and Science Study (TIMSS) Student Questionnaire has been widely used for measuring students' attitudes toward science, there remains a dearth of evidence validating its latent factor structure and measurement invariance. We tested exploratory structural equation (ESEM) and confirmatory factor analysis (CFA) models using a bifactor structure to identify the best-fitting model for the science attitudes items. This study found that the bifactor ESEM model was the best fitting solution, comprised a general factor and three secondary factors of enjoyment, self-confidence, and perceived value in learning science. Furthermore, we included testing for configural, metric, and scalar invariance across gender groups using the ESEM bifactor model. The TIMSS science attitude items showed strong measurement invariance across genders. This result indicated that the instrument measures the same latent variable for both female and male students, so any observed gender differences in students' "attitudes toward science" scores can be considered to reflect true differences.

## Concurrent Paper Session 5: Wednesday 9:15am – 10:15am

### Session 5A: Exploratory Data Analysis

#### **Comparison of exploratory data mining approaches for understanding adolescent recovery capital**

*Emily A. Hennessy, Emily E. Tanner-Smith, and Andrew J. Finch*

Research suggests that adolescent recovery from substance use disorders is a complex and dynamic process requiring multiple resources at intersecting ecological levels. The recovery capital framework is one theoretical framework that allows for the modeling of these different resources, but has only been studied among adult populations. Thus, the present study explores the relevance of recovery capital for adolescents by incorporating a demonstration of exploratory methods for social scientists studying similar complex issues and populations. This paper uses data from an ongoing observational study to address whether recovery capital resources predict attendance at a recovery high school (RHS), one form of community recovery capital, using three quantitative approaches: logistic regressions, classification trees, and random forests. The results of this study indicate that predictors of RHS attendance are diverse, represent factors in multiple recovery capital domains, and are not necessarily linked to higher levels of recovery capital. Additionally, the different exploratory approaches highlight potentially important variable interactions for future research to explore. This study demonstrates both the utility and potential challenges of utilizing exploratory quantitative methods to study complex social science research questions.

#### **Exploratory Mediation Analysis with Many Mediators**

*Erik-Jan van Kesteren and Daniel Oberski*

Mediation analysis is an established procedure for investigating the direct and indirect components of an effect with a single or a few theoretically relevant potential mediators. Recently, technologies such as fMRI and smartphones have enabled novel data collection methods yielding theory-sparse, high-dimensional datasets. As these wide datasets become more prominent in the social and behavioral sciences, exploratory mediation analysis is becoming more relevant. We show that existing methods for exploratory mediation analysis with many mediators do not perform uniformly well: (a) classical SEM modelling is unavailable as the full model is unidentified, (b) considering each potential mediator individually is possible but strictly assumes uncorrelated mediators, and (c) a recently introduced regularized SEM method only works when the mediation path is relatively strong. To solve some of these issues, we propose a hybrid method which we call the Coordinate-wise Mediation Filter (CMF). Through a simulation study under theoretical boundary conditions we show that this method does not fail in cases where other methods do. This makes it a promising technique for general exploratory mediation analysis.

### Session 5B: Latent Class Tree Models

#### **Using Latent Class Trees to Classify New Students in an Adaptive Assessment Progression**

*John P. Madura*

This study introduces a novel approach for developing an adaptive assessment progression based on the use of latent class trees (LCTs). Student responses to a cognitive assessment with a hypothesized tree structure were modeled using both traditional latent class analysis and latent class tree analysis. Both models were then applied to an adaptive testing framework for the classification of new students. The study found that the latent class tree model improved the adaptive testing

process for classifying new students by facilitating the interpretation of classes in two dimensions. In the first dimension, the use of latent class trees resulted in the improved interpretation of the terminal classes hypothesized by the assessment domain. In the second dimension, the graded nature of the latent class tree structure provided for more opportunities for meaningful classification of students over the entire adaptive testing process.

### **An improved latent class (LC) paradigm to obtain meaningful segments in the presence of scale confounds: Scale Adjusted Latent Class (SALC) Tree modeling**

*Jay Magidson*

Accounting for both mean and variance (scale) heterogeneity is important in discrete choice modeling in order to obtain estimates of preference that are free from scale confounds (strength of preference), and to obtain meaningful latent class (LC) segments that differ on their preferences. We propose a new model and related methods that extend LC tree (LCT) modeling to utilize two categorical latent variables, one to separate out the effects of scale, the other to obtain meaningful segments that differ solely in their preferences. We apply this model to discrete choice response data containing both preference and scale heterogeneity and evaluate the effectiveness of this new model to remove scale confounds and classify respondents into meaningful LC segments. Results show that the new SALC Tree approach reveals policy relevant segments very similar to those hypothesized to exist by the researcher prior to the analysis, while the segments obtained by the traditional LC and LCT models are clearly confounded with scale. This new method is being implemented in version 6.0 of the Latent GOLD® program.

### **Session 5C: Modeling Single Case Designs**

#### **Analysis of Single-Case Experimental Count Data Using the Linear Mixed Effects Model: A Simulation Study**

*Lies Declercq, Laleh Jamshidi, S. Natasha Beretvas, Mariola Moeyaert, John M. Ferron, Wilm Van den Noortgate, and Belen Fernandez-Castilla*

When (meta-)analyzing single-case experimental design (SCED) studies by means of multilevel modeling, applied researchers almost exclusively rely on the linear mixed model (LMM), assuming normally distributed residuals. However, very often SCED studies consider outcomes of a discrete nature and then the normality assumption does not hold. The LMM can be extended into a generalized linear mixed model (GLMM) to account for the discrete nature of SCED count data, but the GLMM is more complex and therefore harder to understand and explain. In this simulation study, we look at the effects of using an LMM to fit SCED count data. We compare the performance of the LMM and GLMM in terms of goodness of fit, fixed effect parameter recovery, Type I error rate and power. The results show that, compared to the GLMM, the LMM has worse performance in terms of goodness of fit and power but better performance in terms of Type I error rate. Fixed effect parameter recovery is equally good for both models. Finally, we provide some guidelines for applied researchers about aspects to consider when using an LMM for analyzing SCED count data.

## **Synthesizing Single-Case Studies via Multilevel Models: Limitation of Model Complexity**

*Ke Cheng, Zhiyao Yi, John Ferron, Mariola Moeyaert, S. Natasha Beretvas, and Wilm Van den Noortgate*

Researchers are more frequently turning to multilevel models as a way of meta-analyzing single-case studies. Because change in behaviors over time can be complex, meta-analysts working to synthesize single-case data have a variety of models to choose between, and because of the nature of single-case studies, there is limited data available to guide these choices. This study contributes to the applied work of meta-analysts by indexing the consequences of over specifying and under specifying models in this context. In our simulation study, data are being generated assuming a three-level model (observations nested in cases nested in studies). The observations for each case are being generated using a linear model with no trend in the baseline phase and a logistic model during the treatment phase). Level-1 errors are being generated to be autocorrelated and heterogeneous across phases and cases, whereas level-2 and level-3 errors are generated under both correlated and uncorrelated conditions. In addition, a set of design factors are considered, including number of observations per case (16 and 32), the number of cases (4 and 8), and the number of studies (10 and 30). We aim to estimate treatment effect bias when using relatively simple models and those with increasing levels of complexity in the variance structure and increasing levels of complexities in the fixed effects.

## **Session 5D: Latent Variable Modeling**

### **Estimation and Application of the Latent Group Model**

*Joseph Bonito, Jennifer L. Ervin, Sarah M. Staggs*

Group scholars often describe or conceptualize groups as having characteristics similar to those of individuals. For example, groups can be thought of as motivated or satisfied in degree. Describing groups in such terms assumes that members possess similar levels of the characteristic in question and that latent group-level processes influence convergence on that characteristic. The latent group model (LGM) offers conceptual and statistical means for assessing the structure of latent, group-level factors based on the convergence of variables measured at the individual level. This paper outlines the conceptual issues related to the LGM and offers a detailed example using interaction data from 4-person groups for estimating the model in SAS, SPSS, Mplus, and R syntax are provided in the appendixes. Applications and extensions of the LGM are discussed.

### **Quantifying estimation uncertainty by examination of fungible parameter estimates in SEM**

*Jordan L. Prendez and Jeffrey R. Harring*

Previous research has suggested that marginal decreases in model fit can produce a range of equally fitting fungible parameter estimates that, at times, may lead to very different substantive interpretations. Whereas standard errors represent a measure of uncertainty tied to sampling variability, fungible parameter estimates describe a distinct type of uncertainty related to model fit. An examination of fungible parameter estimates, presents information that can be used to either strengthen or weaken subsequent interpretation of parameter estimates. Methods for exploring parameter stability relative to small decrements in model fit have been proposed for several models (e.g., multiple regression, logistic regression, structural equation models). However, these methods are limited and are difficult for applied researchers to implement. The current project utilizes a simulated annealing algorithm as a novel method for exploring the fungible parameter space. Finally, the proposed method is implemented in an open-source package in R which allows researchers to examine the stability of their own model and data.

## **Concurrent Paper Session 6: Wednesday 10:30am – 12:00pm**

### **Session 6A: Educational and Social Applications**

#### **School performance and environmental factors among students in Kenya context: Dealing with endogeneity**

*Mwarumba Mwavita and Simon Wagura*

In this study we present the effect of students work related activities and school attendance using a cross-sectional data from a local county in Kenya. Since the decision to work and attend school is jointly determined in this context, we used a bivariate probit to model these decisions. In addition, with a number of variables exhibiting possible endogeneity, we employed instrumental variables to the equation in the probit estimation. Thus the paper will provide the method we used, results from the data, implications to ways of dealing with endogeneity, as well as practice.

#### **Getting a Clear Picture of Kindergarten Learning and Performance**

*Ya Mo and Nell Sedransk*

Using Early Childhood Longitudinal Study-Kindergarten Fall 2010 and Spring 2011 data, this study investigated factors from students' demographic backgrounds to ascertain their relationships to students' academic performance in reading and in math by the spring of the kindergarten year. This study utilized a data-driven analytic approach regression tree analyses. The results have shown that the patterns illuminated by the regression trees differ across the subject areas (i.e., reading and math) and between the performance levels and achievement gains. The math and reading performances of the upper, middle, lower end of kindergarteners on the SES scale were variously related to different factors (i.e., race, region, and gender). For reading gain related, important factors included some of the same factors but also depend on location types (i.e., cities, suburbs, towns, and rural areas). The picture differed for math gain because racial groups performed differently based on their school's characteristic %FRPL and geographic designation. This study has shown that regression tree analyses can be utilized with observational or survey data in education to display complex patterns between factors and outcomes that would be obscured by trying to model the entire population as a whole.

## **Session 6B: Symposium – Substance Use Focused Mediation Modeling**

Chair: Bettina Hoepfner

Structural equation models in general and mediation models in particular present powerful tools to explore and test complex hypotheses about causal pathways. In this symposium, we will present four case studies of the application of mediation and structural equation models to questions in the field of substance use research. The selected case examples will demonstrate the uses of multiple mediation, serial mediation, and structural equation modeling to explore a wide variety of mechanistic and causal questions related to substance use initiation, problematic use of alcohol or marijuana, proximal cognitive impacts of marijuana use, and mechanisms of change in smoking cessation. The models were conducted in SAS 9.4 using either PROC CALIS or the PROCESS macro (Hayes, 2013), SPSS using the PROCESS macro, or Mplus 7. Each presenter will discuss the motivation behind each model, the analytical challenges encountered along the way, and how they ultimately arrived at final model, given these challenges.

### **Paper 1: The Factor Structure of Self-Esteem and Its Relationship to Alcohol Use in American Indian Adolescents**

*Melissa R. Schick, Tessa Nalven, Natasha Prasad, and Nichea S. Spillane*

### **Paper 2: How do text-messaging smoking cessation interventions confer benefit? A multiple mediation analysis of Text2Quit.**

*Bettina B. Hoepfner, Susanne S. Hoepfner, and Lorien C. Abrams*

### **Paper 3: Early onset marijuana use is associated with learning inefficiencies**

*Randi M. Schuster, Susanne S. Hoepfner, Anne E. Evins, and Jodi M. Gilman*

### **Paper 4: A reinforcement sensitivity model of affective and behavioral dysregulation in marijuana use and associated problems**

*Noah N. Emery and Jeffrey S. Simons*

## **Session 6C: Mixture Modeling Applications**

### **Modeling of Self-Report Behavior Data using the Generalized Covariates in a Uniform and Shifted Binomial Mixture Model**

*Holmes Finch and Maria Hernandez Finch*

Social scientists routinely collect data using questionnaires and surveys. Items on these instruments frequently involve scales with multiple ordered options that respondents use to report intensity of feelings or behaviors. Given their popularity, a variety of statistical models have been developed for analyzing data collected using these items. A model that has been recently described for working with ordinal items is the Covariates in a Uniform and shifted Binomial mixture (CUB). The CUB model characterizes responses to ordinal items as a function of two parameters: (1) response feeling (or intensity), and (2) response uncertainty. This model has been extended to include a third parameter measuring likelihood of respondents selecting a socially desirable or safe response, known as the shelter option. The purpose of this study is to apply an extension of the CUB to the modeling of substance use behavior by teenagers. This model has been primarily used to investigate items measuring political opinions, or product preferences. However, the CUB with a shelter parameter and covariates (GeCUB) seems particularly well suited for characterizing self-reported behaviors, particularly those that are not considered positive (i.e., substance abuse). Results from the GeCUB model estimation revealed that subjects used the 'No use' response as a shelter option at relatively high rates for marijuana use, but not for cigarettes or alcohol. In addition, females were more likely to report less use and less certainty in their responses than were males.

### **Cluster Effects on Parameter Estimation in Multilevel Regression Mixture Models**

*Chi Chang and M Lee Van Horn*

This study challenges the utility of multilevel regression mixture models and the robustness of their slope estimates. Such models have been applied in education research and social-science studies but discussion of how cluster effects and violations of distribution assumptions affect their parameter recovery has been rare. This paper pushes the cluster effect to 0.7 and increases the magnitude of skewness in the distribution of latent-class probabilities among the higher-level units to an extreme and examines nine conditions using parametric and nonparametric approaches. The findings provide evidence of the robustness of parameter estimation in multilevel regression mixture models, but also point to new concerns for future applied researchers.



## **Session 6D: Bayesian Thinking**

### **Operationalizations of inaccuracy of prior distributions in simulation studies: implications for recommendations made for applied researchers**

*Milica Miocevic*

The most controversial aspect of a Bayesian analysis is the selection of prior distributions. There have been several simulation studies evaluating the impact of inaccurate prior distributions on statistical properties of posterior summaries of model parameters (Depaoli, 2013; 2014; Miocevic, Levy, & MacKinnon, under review). However, the findings of such simulation studies depend heavily on the operationalization of inaccuracy and informativeness of priors. This talk presents several possibilities for designing inaccurate priors for a simulation study and communicates the results of a simulation study used to compare the consequences of two different conceptualizations of inaccurate priors on recommendations made for applied researchers. The talk offers several options for constructing inaccurate priors for simulation studies that mimic real-life scenarios for how applied researchers might inadvertently specify inaccurate priors. This project aims to demonstrate that as methodologists, we should include multiple types of inaccurate priors in simulation studies used to examine statistical properties of Bayesian methods with inaccurate priors.

### **Towards Bayesian Small-Sample Variance Components: Gentle Introduction for the Newcomer**

*Jonathan Templin, Tyler Hicks, and Lesa Hoffman*

To model data from units nested in clusters or repeated measures, scientists turn to mixed models. Mixed models define both fixed and random effects. Bayesian scientists could describe point estimates of variance components with the maximum a posterior (MAP; “posterior mode”), the expected a posterior (EAP; “posterior mean”) or the M-posterior (“posterior median”). Whereas these posterior statistics will converge with large samples, they will diverge with small samples – a proviso frequently forgotten in simulation studies comparing Bayesian and likelihood-based point estimates of variance components. Although switching to the MAP will help calibrate small-sample estimates of variance components to be unbiased, many MCMC simulation packages will not output the MAP. In this methodological illustration presentation, we propose a simple workaround that Bayesian scientists could use to obtain the MAP. We provide our own SAS program to execute this method. We also offer a few examples of applications and outputs and discuss implications.

## **Session 6E: Symposium – Recent Advanced in Online-Updating Methods for Regression-type Models Involving Big Data Streams**

Chair: Ofer Harel

For big data arriving in streams, online updating is an important statistical approach that breaks the memory storage barrier and also the computational barrier under certain circumstances. In this session, we present online updating methods for statistical estimation and inference under different regression settings (linear models, generalized linear models, estimating equations, Cox models), where large amounts of data arrive in streams and require fast analysis without storage/access to the historical data.

### **Paper 1: Online Updating of Statistical Inference in the Big Data Setting**

*Elizabeth D. Schifano*

### **Paper 2: Online Updating of Survival Analysis in the Big Data Setting**

*Jing Wu*

### **Paper 3: Proportional Hazards Tests and Diagnostics in the Online Updating Setting**

*Yishu Xue*

## Concurrent Paper Session 7: Wednesday 1:15pm – 2:15pm

### Session 7A: Modeling Applications

#### **The Longitudinal Associations Between Substance Use, Crime, and Social Risk Among Emerging Adults: A Longitudinal Within and Between-person Latent Variables Analysis**

*Gabriel J. Merrin, Jordan P. Davis, Daniel Berry, Elizabeth D'Amico, and Tara M. Dumas*

Background: The reciprocal relationship between crime and substance use is well known. However, when examining this relationship, no study to date has disaggregated between- and within-person effects, which represents a more methodologically sound and developmentally-appropriate analytic approach. Further, few studies have considered the role of social risk (e.g., deviant peers, high-risk living situations) in the aforementioned relationship. We examined these associations in a group of individuals with heightened vulnerability to substance use, crime and social risk: emerging adults (aged 18 - 25 years) in substance use treatment. Methods: Participants were 3479 emerging adults who had entered treatment. We used auto-regressive latent growth models with structured residuals (ALT-SR) to examine the within-person cross-lagged association between crime and substance use and whether social risk contributed to this association. A taxonomy of nested models was used to determine the structural form of the data, within-person cross-lagged associations, and between-person associations. Results: In contrast to the extant literature on cross-lagged relations between crime and substance use, we found little evidence of such relations once between- and within-person relations were plausibly disaggregated. Yet, our results indicated that within-person increases in social risk were predictive of subsequent increases in crime and substance use. Post-hoc analyses revealed a mediation effect of social risk between crime and substance use.

Conclusions: Findings suggest the need to re-think the association between crime and substance use among emerging adults. Individuals that remain connected to high-risk social environments after finishing treatment may represent a group that could use more specialized, tailored treatments.

### Session 7B: Modeling Health Disparities

#### **Modeling Health Disparities with a Unique Combinations of 1-on-1 Matching and Latent Difference and Latent Change Scores**

*Emil Coman, Christina Wilson, Alyse Melville, and Judith Fifield*

We try to answer simple questions about racial/ethnic (R/E) differences in health outcomes, like: how do Black and Hispanic young fathers change their attitudes about parenting after 12 months in an intervention? When R/E groups are compared, some form of matching is required, because R/E is not randomized (as gender is). We showcase an old 1-on-1 matching method on several background variables [1], which creates pairs of comparable cases, hence the data becomes dyadic, or repeated measures, across the two groups to be compared. Since repeated measures can be modeled with latent change/difference scores, by simply regressing the 2nd score on the 1st score and the LDS/LCS latent [2], we create first latent difference scores (LDS) for Black vs. Hispanic comparisons in the outcome. Because we are interested in the actual changes from baseline to 12 months, we do this for both baseline (time 0) LDS0Bvs.H, and the 12-month (time 1) outcomes LDS1Bvs.H. We can now investigate the change in the R/E differences/disparities, by creating an additional latent change scores (LCS1B vs. H), using LDS0Bvs.H as the 1st score and LDS1Bvs.H as the 2nd score. This model estimates (simultaneously) the change over time in disparities, obtained initially with a more meaningful one-on-one direct contrast between pairs of comparable cases. This model hence estimates the R/E differences in changes over time. We illustrate such

comparisons of Hispanic and Black young fathers enrolled in an urban intervention, after matching them 1-on-1 on: age, high school, whether still in school, 4 level employment status and a 15 index of barriers to seeking employment. We provide Stata and Mplus code for all steps and final analyses. Several challenges in specifying the models and solutions are discussed, like the impact of constraining the intercept of the 2nd score. This model uses two modern tools, LDS and LCS and an older matching tool, to answer health disparities HD questions about changes in health outcomes.

### **A Methodological Review of the Causal Role of Socioeconomic Determinants of Health Disparities**

*Emil Coman, Shervin Assari, & Helen Z. Wu*

We present the results of an extensive scan of the health disparities (HD) research documenting the complex role of socio-determinants of health, aiming to develop a truly big picture of all the factors with influence on augmenting or reducing HDs. The process is a methodical causal discovery process, meant to assess the evidence for the role of socio-economic determinants of health. We review the role of a number of factors located causally at different levels: 1. Individual: parental education and educational attainment; subjective social status; self-efficacy; beliefs and behaviors; discrimination; resilience, income & assets/wealth. 2. Social: neighborhood distress/order and safety; residential segregation; social capital; collective efficacy. 3. Structural level: poverty and unemployment; structural racism; socioeconomic stratification. Mixed findings will be particularly emphasized, like the role of socio-economic status (SES) indicators, positioned alternatively in research reports as either primary or intermediary causes, or even as co-effects of health problems; the causal role of race/ethnicity itself (how can race cause any health outcomes?); the shifting roles of co-variables like age and gender. The benefits of such a systematic causal modeling search are multiple. First it will inform theoretical models explaining the mechanisms of HD development and potential for reduction, suggesting better avenues of intervening to policy makers. Secondly it provides a knowledge bank for researchers interested in formulating hypotheses and deciding on what variables to collect/not and analyze/not. Thirdly, it can act as the building phase of a large causal systematic research synthesis (or causal meta-analysis) that can formally establish the strength of evidence behind each causal link in the big picture.

### **Session 7C: Symposium – Advances in Handling Complex Nested Data Structures in Multivariate Multilevel Models**

**Chair: Katherine Masyn**

The use of hierarchical generalized linear models (HGLMs) for nested data has spread so effectively in applied empirical research in the educational and social sciences that it may now be considered common convention in the realm of analytic approaches. Methodological extensions of HGLMs into multivariate models settings, such as structural equation model, latent growth curve modeling, and finite mixture modeling, have been increasing in prevalence as have applications enabled by expanding software capabilities. However, advancements in the HGLM framework to handle complex nested data structures e.g., cross-classified and multiple-membership nesting are at earlier stages of development. Similar extensions to multivariate model settings are nascent but necessary given the ubiquity of these complex nested structures in population-based research. Our symposium brings together three papers that each address one of these extension opportunities. The first paper extends the multiple-membership growth curve model to situations in which final levels, rather than baseline levels of the growth outcomes, define the random intercept. The second paper examines the performance of a proposed approach accounting for multiple-membership in a

piecewise growth curve model. The third and final paper examines the impact of ignoring cross-classified nested data in a multilevel latent class analysis and demonstrates the model specification and estimation procedure appropriate for the complex nesting.

**Paper 1: A New Way for Handling Student Mobility with Longitudinal Data in Educational Research**

*Congying Sun, Audrey Leroux, and Christopher Cappelli*

**Paper 2: Evaluation of a Piecewise Growth Model for Multiple Membership Data Structures**

*Christopher Cappelli, Audrey Leroux, and David Fikis*

**Paper 3: Multilevel Latent Class Analysis for Cross-Classified Data Structures**

*Katherine Masyn and Audrey Leroux*

**Session 7D: Sensitivity Analysis in Latent Growth Curve Mediation Models**

*Davwood Tofighi, Yu-Yu Hsiao, Eric S. Kruger, David P. MacKinnon, M. Lee Van Horn, and Katie Witkiewitz*

Increasingly complex mediation models with two or more mediators have become more prevalent in the literature. One important application of multiple mediation models is the latent growth curve mediation model (LGCMM), whereby some treatment variable is expected to affect the latent intercept and latent slope, which in turn affect a distal outcome. As an example, the effect of an anti-craving medication on reducing alcohol consumption is hypothesized to be mediated through two growth factors: a) initial state of craving after stabilization on medication, and b) weekly rate of change in craving. Even with random assignment, a critical but untestable assumption for valid and unbiased estimates of the indirect effects in LGCMM, as in any mediation model, is the no omitted confounder assumption that states there should be no omitted variable that confounds indirect effects in the model. One way to address this untestable assumption is to conduct sensitivity analysis to assess whether the inference about an indirect effect would change under varying degrees of confounding. We developed and apply sensitivity analysis to the case of two latent mediators that represent a growth mediation processes. Our method involves computing the biasing effect of confounding on point and interval estimates of the indirect effects in a structural equation model (SEM) framework. We provide R code that uses Mplus to conduct sensitivity analysis for any mediation model in the SEM framework with two latent mediators. We present plots to visually summarize the effects of confounding on each indirect effect. An empirical example is used to illustrate the application of the sensitivity analysis including computer code.

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# Poster Abstracts

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## 1. Assessing the Impact of Low Variability

*Cara Arizmendi and Kathleen Gates*

Whether to include variables with low variability in analyses is a common predicament for researchers, especially in daily diary and ecological momentary assessment (EMA) studies where some variables may be near-constant for some individuals across time. Much like high multicollinearity, low variability variables will have a determinant near zero. Thus, similarly to problems seen with multicollinearity, we may expect that retaining low variability variables in our models would result in inflated standard errors of the other, normal-variance variables in the model. Despite this predicament and the frequency of obtaining intensive longitudinal data with one or more variables with low variability, the impact of low variability on estimation of other variables in the model has yet to be explored. By failing to consider the impact on estimation rather than the level of variability, researchers may be removing theoretically meaningful and possibly explanatory variables. Here, we present a simulation study exploring the impact of low variability on the standard errors of beta estimates in linear regression. Simulations varying over strength of correlation, level of variability, and sample size suggest the stability of standard errors of normal-variability variables despite the presence of a low variability variable and the instability of the standard errors of the beta estimate for variables with extremely low variability.

## 2. Performance of the LMS Procedure in Estimating Latent Interaction Models with Ordered-Categorical Indicators

*Ezgi Ayturk and Heining Cham*

Several procedures have been developed and extensively examined to estimate latent interaction models with continuous data (see Marsh, Wen, & Hau, 2004, for a review). There are also three specialized estimators for estimating such models with categorical indicators, which theoretically have identical asymptotic properties. Among these three, a maximum likelihood estimator called the Latent Moderated Structural Equations (LMS; Klein & Moosbrugger, 2000) is readily available in commercial software, easier to implement, and can be used with both dichotomous and ordered-categorical data. The purpose of this simulation study was to investigate for the first time the performance of LMS method in estimating latent interaction models with ordered-categorical data. We investigated both structural and measurement model parameter estimates of LMS under different number of indicator categories, category-symmetry, interaction effect size, missing data mechanism and rate, and sample size conditions, in comparison with a popular continuous data method called the Unconstrained Product Indicator (Marsh et al., 2004) method. LMS resulted in high convergence rates, unbiased main and interaction effect parameter and standard error estimates, desirable power and coverage levels, and Type I error rates. However, it produced biased factor loading estimates. An example may be provided to illustrate the LMS method with categorical indicators.

### **3. RMSEA for Nested Model Comparison**

*Jordan Brace*

Comparing fit of nested structural equation models using differences of fit indices, such as the RMSEA, rather than test statistics, has become common in psychological research, particularly in investigations of measurement invariance. Typically, this is done by computing an absolute difference of RMSEAs, such that  $RMSEA.D = RMSEA.1 - RMSEA.0$ , where  $RMSEA.0$  is the less restrictive of the models being compared, and  $RMSEA.1$  is the more restrictive of the models being compared. An  $RMSEA.D$  of .01 is frequently cited as the critical difference for model rejection. We demonstrate that when nested models are correctly specified, the 95th percentile of RMSEA differences varies considerably as a function of the degrees of freedom of the models being compared, suggesting that a single critical value for model rejection is inappropriate. We demonstrate that computing an RMSEA using the non-centrality parameter and degrees of freedom associated with the chi-square difference between models produces a far more stable index of fit across model sizes, justifying the use of critical values for model rejection. A series of Monte Carlo simulations are conducted comparing the traditional and adjusted RMSEA in the contexts of comparing nested classical test theory models and measurement invariance models.

### **4. Evaluation the Intervention Effect in the LIFT Project with the Longitudinal Mediator**

*Chuang Chen, Shu Xu, John Mark Eddy, Sara Nichols*

This project examined how the deviant peer association mediated the intervention effect on the substance use in adolescents including tobacco, beer, wine, hard liquor, and total in the Linking the Interests with Parents and Teachers Program over time. The project used seven waves of longitudinal data collected from 141 males and 143 females who were age 10.5 at Time 1 and age 17.8 by Time 7. Latent growth curve model was used to develop trajectory of deviant peer association behaviors and substance use. The growth curve mediator model was used to evaluate the deviant peer association mediator effect between intervention and substance use. No growth, linear and quadratic growth curve models were used to fit the trajectory of deviant peer association, total substance use, tobacco use, beer use, wine use and hard liquor use. The deviant peer association and wine use fitted the linear growth curve model better while total substance use, tobacco, beer, and hard liquor fitted the quadratic growth curve model better. The intervention showed a slightly higher growth rate of deviant peer association over time ( $p < 0.05$ ). The direct effect of intervention was significant on tobacco both linear term ( $b = 0.81$ ,  $p < 0.05$ ) and quadratic term ( $b = -0.106$ ,  $p < 0.05$ ), while other substances showed the intervention was no significant effect. The intervention presented an effect on deviant peer association behavior of participants while no statistically significant on the substance use except tobacco. The previous study of LIFT program showed that controlling the deviant peer association, the intervention showed a decreasing effect on the substance use. So, the next step of the project will do a longitudinal mediator analysis to explore whether the deviant peer association will modify the relationship between the intervention and substance use.

## **5. Accounting for the Uncertainty of Nuisance Parameter in Power and Sample Size Calculation**

*Chuchu Cheng and Hao Wu*

In this paper we propose a new method of power and sample size calculation in dependent t test and independent t test. In practice, power and sample size are commonly calculated using textbook formulas that involve both effect size and some nuisance parameters. For example, the nuisance parameter can be the correlation between two measures in dependent t test, and variance ratio of the two groups in independent t test. While researchers can specify the size of effect to be detected, the nuisance parameter is usually estimated from a previous study or a pilot study. Thus, there is randomness in the nuisance parameter estimate. In most studies, the point estimate of nuisance parameter is used, which ignored its uncertainty. To improve the estimation accuracy and computation efficiency, we construct the confidence intervals of power or sample size from the confidence interval of the nuisance parameter to account for its randomness. Simulation studies were conducted to compare different bootstrap methods, maximum likelihood and Delta method in constructing the confidence intervals.

## **6. The Impact of Extreme Response Styles on Parameter Recovery with Variables of Different Levels of Skewness**

*Zixin Ding, Kirstie Turnbull, Kevin Tao, and Allen G. Harbaugh*

This poster presents the findings of a simulation study designed to assess the impact of response styles on parameter recovery 2 and 3 factor structural equation models. A variety of models were simulated with and without contamination from exclusively extreme and extreme avoiding response styles. In addition, the manifest variables were modelled to demonstrate little to extreme degrees of skewness in the categorical data response categories. Effects of response styles will be examined in relation to key parameter recovery in respective models, overall model fit (assessed with multiple fit indices such as CFI & RMSEA), and impacts on factor loadings. Additionally, these effects will be tested to see how they may or may not be moderated by the degree of skewness in the variables. Plans for future simulation studies will be discussed.

## **7. Extending the Curve of Factors Model to Accommodate Non-Ignorable Missingness**

*Anthony J. Gambino, Aarti P. Bellara, and Kevin Agnello*

This study extends the Curve of Factors (CUFFS) model, a second-order latent growth curve model, to the case of data that are not missing at random (NMAR). It does this by presenting, via simulation study, how the CUFFS model can be specified with missing data indicators in similar fashion to first-order latent growth curve models for NMAR data that have been proposed in the past. These include the shared parameter model, the selection model, and the pattern mixture model. The performance of the CUFFS model, shared parameter CUFFS model, selection CUFFS model, and pattern mixture CUFFS model was evaluated in the presence of missing at random (MAR) data and NMAR data.

## **8. Understanding how career-family sequences influence each other in the transition to adulthood using Multi-channel (Latent) Markov chain models**

*Y. (Sapphire) Han, A. C. (Aart) Liefbroer, and C. H. (Cees) Elzinga*

Recent theories about social and demographic change suggest the emergence of de-standardized and diversified pathways to adulthood. The transition to adulthood is a phase in the life course where many interlinked and gendered events like leaving the parental home, and entering the labor-market and/or postsecondary education take place. Research linking the family to career trajectories is scarce. Our previous work demonstrated the usefulness of applying Latent Markov models to uncover the mechanisms driving the family formation process and the roles played by gender and education. Using multi-channel Latent Markov Models, we examine the extent to which family and career sequences influence each other during the transition to adulthood, and we test hypotheses concerning the effects of gender and social class using data from the National Longitudinal Survey of Youth from 1997, a panel study conducted by the U.S. Bureau of Labor Statistics, which provides full monthly life course sequence data of men and women between age 17 to 27.

## **9. Time-Varying Effects and Mediation in Survival Modeling**

*Tim Janssen, Melissa J. Cox, Jennifer Merrill, and Kristina Jackson*

We demonstrate a structural equation modeling (SEM) implementation of survival modeling, which allowed us to model and test for time-varying or time-invariant effects of time-varying predictors. Further, we demonstrate how we tested mediation in this context. In the practical implementation of this analysis strategy, we show how psychological mechanisms mediated the effect of movie alcohol exposure on hazard rates of alcohol use initiation milestones over time, among Rhode Island adolescents (N=1,023, 52% female, age 13.7 years) from 5 representative middle schools. Results indicate that the effect of movie alcohol exposure on hazard of alcohol use initiation (greater exposure leading to increased risk) was significantly mediated by multiple mechanisms. Based on bootstrapped joint significance tests, there was significant mediation by peer descriptive (95% CI: .004, .101) and injunctive (99% CI: .032, .214) norms, as well as susceptibility (99% CI: .014, .189). In these cases, exposure led to greater perceived norms and susceptibility, which in turn led to greater hazard for alcohol initiation. We discuss the benefit of our SEM implementation as well as challenges and limitations in fully realizing this benefit.



## **10. An Investigation of Weighted Root Mean Residual with Categorical and Continuous Data**

*Ning Jiang, Jin Liu, Dexin Shi, and Christine DiStefano*

Structural equation modeling (SEM) techniques are extremely popular in the social science to test theoretical perspectives. Broadly, global fit indices are used to provide an initial description of a tested model. The Weighted Root Mean Square Residual (WRMR) is a relatively new fit statistic that is increasingly used for support of model-data fit. However, few studies have investigated the performance of this index. This study aims to use a simulation study to examine the performance of the WRMR when categorical and continuous data are analyzed. Conditions such as model size, sample size, magnitude of factor loadings, item distribution, and misspecification will also be varied to investigate the sensitivity of the WRMR fit index. Mplus (v. 8) will be used with the robust estimators of weighted least squares with a mean- and variance-adjusted chi-square (WLSMV) and maximum likelihood with a mean- and variance-adjusted chi-square (MLMV) correction. The performance of the WRMR will be compared to other well-known fit indices (i.e. global  $\chi^2$ , SRMR, TLI, CFI, and RMSEA). This study can help applied researchers by providing information about the WRMR fit index under situations that may be encountered with empirical research.

## **11. An Investigation of Statistical Power and Sample Size for CFA Models with Ordinal Data: A Monte Carlo Study**

*Ning Jiang, Christine DiStefano, Jin Liu, and Dexin Shi*

Determining the minimum sample size to reach adequate statistical power (e.g., 0.8) is one of critical steps for researchers. Rules of thumb are typically used to estimate minimum sample size in structural equation modeling (SEM) (e.g., N:p ratios). However, such rules are not always accurate, and determining sample size and power challenges many applied researchers. Further, many studies investigating power in the SEM field have considered continuous data. As ordinal data are often analyzed, further research involving discrete data are needed. This study aims to use Monte Carlo method to examine minimum sample size to reach adequate statistical power (0.8) when categorical data are analyzed. The simulation will vary factors such as the number of categories, magnitude of factor loadings, misspecification levels, and item distribution. Mplus (v. 8) with weighted least squares with a mean- and variance-adjusted chi-square (WLSMV) will be used as the analysis method. Preliminary results are consistent with the previous research which indicates that magnitude of factor loadings, number of categories, and data normality impact minimum sample size and power requirements.

## **12. Analyzing Time Series with Long Range Dependencies 1: Using Fractional Differencing to Detect Irregularity**

*Matthijs Koopmans*

The purpose of this poster is to provide an overview of fractional differencing (Beran 1994), a recently developed technique to analyze long-range irregular patterns in time series data, and show its application using two illustrative datasets: 1. The quarterly discharge volume of the River Nile from 622 through 1248 AD (classic dataset), and 2. Daily attendance rates in one New York City high school from 2010-2014. The main features of fractional differencing are explicated, and it is shown how irregularity manifests itself in the time series and diagnostic autocorrelation function plots of these data. Parameter estimates (the differencing parameter  $d$  and the Hurst exponent  $H$ ) are generated and interpreted for both datasets, and the need for a competitive modeling approach is illustrated to estimate the effects of  $d$  and  $H$  over and above the effects of the conventional time series modeling parameters. Statistically significant differencing parameters are often seen as an indication of self-similarity and metastability, suggesting complex adaptive processes. The strengths and weaknesses of this interpretation are discussed. The script to conduct these analyses using the `fracdiff` package in R is provided.

## **13. Analyzing Time Series with Long Range Dependencies 2: Using Exponential Smoothing to Model Complex Periodic Patterns**

*Matthijs Koopmans*

Traditional seasonal time series models typically estimate short-range regularities (e. g., days of the week), but are not equipped to address long-range dependencies, nested seasonal cycles, or modeling periods including fractions, such as the 365.25 days per year in the Gregorian calendar (De Livera, Hyndman, & Snyder, 2012). The publication of the `forecast` package (*ibid.*) in R has made it possible to analyze such patterns in a relatively user-friendly environment, using exponential smoothing. This poster illustrates the main features of this approach with two datasets: 1. Daily high school attendance rates in one New York City High School from 2009 to 2014, modeling autocorrelations over a school year of 177 days, and 2. Daily recordings of births to teens in Texas from 1964 through 1999, requiring a model that estimates weekly as well as annual dependencies. Diagnostic plots illustrate the need for these models, as does a comparison of their goodness of fit with that of models lacking parameters for complex periodic patterns.

## **14. Modeling Student Academic Preferences and Performance in Foundational Math Courses**

*Chantal D. Larose and Kim Y. Ward*

We perform a learning analytics and predictive modeling investigation of real-world student data to model the interplay between students' academic practices and performance. Segmentation modeling leverages uncovered subpopulations to increase the signal found by our models. Different cost matrices are used to illustrate the effect of treating prediction errors with different weights. Final results include model-based guidelines to aid with future student success.

## **15. Bayesian Approach to Approximate Measurement Invariance Test with Categorical Manifest Variables**

*Jaehoon Lee and Kwanghee Jung*

Any collected data to study scores on latent factors, such as psychological and behavioral research, could possibly produce unreliable results due to measurement biases. This is especially true when data are collected from two or more different groups being compared to one another. Researchers often presume that the measurement tools are the same psychological and behavioral construct in all groups. However, a lack of measurement invariance (MI) leads to a potential bias in the latent mean comparison, and it can pose a possible threat to the validity of a test and inflate Type I error. Thus, conducting the invariance tests is an important procedure to verify whether or not the members of different groups factorial and structural levels are equivalent. Despite, many studies have revealed that the MI assumption is extremely hard to meet. Especially strict forms of MI, in which measurement parameters are exactly the same across groups or measurement occasions, rarely hold. Recent developments in statistics have introduced new analytical tools for evaluating measurement invariance by relaxing strict forms of MI with Bayesian structural equation models (BSEM: Muthen & Asparouhov, 2013). Instead of forcing manifest variables of intercepts to be equal across groups, the parameters were brought closer to one another by using a substantive prior distribution around zero. Van de Schoot and his colleagues (2013) adopted this technique and demonstrated straight forward Bayesian modeling techniques to estimate non-invariant manifest and latent construct parameters using the degree of precision of the prior. However, he used continuous manifest variables, and there are no studies to use categorical manifest variables yet. Therefore, we applied this idea to investigate more details with binary manifest variables. We generated configural, metric, scalar, partial scalar and then approximated MI with 5 different populations to investigate possible bias in each group of latent means. We mainly focused on change of mean and standard estimates, convergence rate, and convergence relative bias for each population.

## **16. An Alternative Approach to Discrete-Time Survival Analysis for Meaningful Interpretation**

*Kejin Lee, Sooyong Lee, and Young Ri Lee*

Discrete time survival analysis (DTSA) allows for estimation of the probability that an event occurs or the hazard function at each discrete time point. While a variety of functions (e.g., shape of the function of hazard probability) can be applied to the DTSA, fitting non-linear functions (e.g., quadratic) to the DTSA makes its parameters interpretation more challenging. Although previous studies suggest alternative ways to estimate and interpret the non-linear functional forms of the growth trajectory by re-parameterizing growth parameters in latent growth modeling (LGM), no study has applied the reparameterization of growth parameters in the LGM to the DTSA (DTSA-LGM). The DTSA-LGM approach provides additional information to quadratic term in the conventional LGM, including the time interval in which the highest or the lowest hazard probability occurs. Hence, we applied the reparameterization of LGM to the DTSA and demonstrated that use of this method facilitates straightforward and meaningful interpretation of growth parameters by fitting the model to data obtained from the National Longitudinal Study of Adolescent to Adult Health (Add Health), 1994-2008 dataset in this study. We also utilized the DTSA-LGM with time-invariant predictors to explore the heterogeneity in the reparameterized version of hazard growth parameters across time intervals.

## **17. The impact of short sleep duration on five latent classes among adolescents with distinct mental and behavioral health profiles**

*Daphne Lew, Hong Xian, Travis Loux, Zhengmin Qian, and Michael Vaughn*

**Objective:** The present analysis seeks to identify latent classes of adolescents with distinct profiles of adverse mental and behavioral health outcomes, and to determine whether insufficient sleep is differentially associated with these classes.

**Methods:** Data from the 2015 Youth Risk Behavior Survey was propensity score matched with sleep duration of less than eight hours per night as the primary exposure. Latent class analysis (LCA) was performed on 11 adverse mental health and behavioral variables to classify adolescents into risk profiles. A multinomial logistic regression was used to determine whether short sleep duration was associated with these profiles.

**Results:** LCA identified five latent classes labeled as follows: low risk, high risk for adverse mental health outcomes, high risk for substance use, high risk for poor body image, and high risk for all outcomes. Students reporting insufficient sleep were more likely to be in any of the high-risk classes, compared to the low risk class, after adjusting for demographic covariates.

**Conclusions:** This analysis identifies five risk profiles of adolescents and indicates strong associations between sleep and these psychosocial profiles. The importance of adopting proper sleeping habits should be emphasized among adolescents, especially for those exhibiting co-occurring adverse outcomes.

## **18. An Evaluation of Parametric and Nonparametric Variance Estimators in Randomized Experiments**

*Stanley A. Lubanski*

This poster presents an evaluation of several parametric and nonparametric variance estimators in the context of a randomized experiment. Recently, nonparametric estimators have been proposed which relax the (frequently violated) assumptions made by the standard sampling variance estimators. However, while the theoretical justification for these nonparametric estimators are clear, it is less clear how well they perform in practice when compared to the standard parametric estimators or, for example, heteroscedasticity-consistent estimators. The aim of this project is to provide such a comparison. Simulation methods were used to evaluate the performance of eleven variance estimators in a randomized experiment. The simulations were repeated across three inference populations, three types of treatment effect heterogeneity, two treatment group sizes, and all combinations thereof. Recommendations for practitioners about which estimator to choose and under what circumstances are provided.

## **19. Systematic Research on Shootings (STRES): Using Traditional and Exploratory Methods to Identify Predictors of Firearm Suicides and Gun Violence Across the Nation**

*Michael Matos, Blair T. Johnson, Kun Chen, Emily Hennessy, Oshin Mathew, and Joshua Lovett-Graff*

Gun violence claims over 30,000 lives per year in the United States. In the hope of reducing gun violence in communities throughout the United States, this project (1) spatially analyzes gun violence and firearm suicide in the United States (2014-2017) and (2) explores socioeconomic and demographic predictors of different types of gun violence (murder and suicide). Gun Violence Archive (GVA), a nonprofit organization dedicated to tracking gun-related violence in the United States, provided the gun violence dataset, which was combined spatially with state, county, and zip code socioeconomic and demographic data from the American Census Survey. Our confirmatory analyses involve a series of Poisson regressions with pre-specified community-level variables to predict gun violence incidence. The exploratory aim uses a Classification and Regression Tree Analysis (CART) with the rpart package in R to analyze the predictors of each type of gun violence. This analytical approach explores the data and identifies interactions; thus, for this analysis, no interactions will be pre-specified. We will train both the Poisson and CART models on the earliest year (2014) and then evaluate the models for years 2015 to 2017. Discussion will center on predicted versus unexpected findings, the most robust predictors of gun violence across four years and identified limitations.

## **20. Examining the 2nd Edition of the BESS TRS-P: Structure and Stability During Preschool**

*Kathleen V. McGrath and Christine DiStefano*

The Behavior Assessment System for Children Third Edition Behavioral and Emotional Screening System, Teacher Form Preschool (BESS TRS-P), identifies children at risk for emotional/behavioral problems. The latest BESS TRS-P form contains 20 of the original 25 items. This change necessitates an investigation as to whether the previously-identified bifactor model structure holds and continues to measure the four latent constructs of Externalizing Problems, Internalizing Problems, Adaptive Skills, and Attention/(Emerging) School Problems (see DiStefano, Greer and Liu, 2016). A sample of pre-school teachers (n=1,108) rated students behavior using a four-point Likert scale (1= Never to 4= Almost always). Individual item scores were combined into an overall index score gauging maladaptive behavior. The current study aims to provide additional information about the reliability and structure underlying the BESS TRS-P and to examine the stability of the constructs measured by the instrument over the course of a school year. Preliminary analyses using exploratory and confirmatory factor analysis procedures support the retention of the bifactor model. However, the resulting item-to-factor loadings may compel the reconceptualization of the latent variables underpinning the instrument. Longitudinal analyses with the best-fitting model will follow to assess the stability of the constructs over time.

## **21. Multiple Imputation Utilizing Hierarchical Clustering in IRT Scoring**

*Grant Orley*

Unplanned missing data are an inevitable complication in testing and measurement without a clear solution. This ambiguity stems from the inability to differentiate the cause of the missing data, and causes logistical problems as well as fairness concerns. Drawing from social networking literature, we propose that a hierarchical clustering of structurally equivalent individuals could be an effective method of imputation. Individuals will be grouped by how alike their pattern of item responses are. These groups could provide additional information for imputation, in the form of dummy codes using. Data was simulated from Item parameters for a 30 item multiple choice math test. Missing data was simulated by drawing a random number from a uniform distribution for each item. An item (i) by person (j) dissimilarity matrix was created with a categorical variable indicating whether the person had answered an item correctly, answered an item incorrectly, or failed to answer an item. A hierarchical clustering algorithm was used to place individuals with the most similar patterns of responses into groups. Dummy coding was then used during MI of the test scores. This method was compared to other common missing data methods in terms of Bias and RMSE of ability estimates.

## **22. Application of Latent Change Score Framework to Studying Changes Based on Different Reference Time Points**

*Minjeong Park, Amery Wu, and Sheila Marshall*

Change over time can be expressed in different ways depending on the reference time point. The flexibility in choosing a reference time point allows the researcher to test a particular hypothesis of his/her interest. However, the commonly applied growth/change model may lack this flexibility. The study extends the latent change score approach (McArdle & Hamagami, 2001) to investigate change using three different references: (1) previous time point, (2) first time point, and (3) second time point. By doing so, researchers can investigate change characterized by different references and also investigate when significant changes occurs. We demonstrate this flexibility with three-year longitudinal data on depressive symptoms from 362 Vancouver high-school students. Change from the previous time point showed a higher level of increase during the first time interval than the second. When the reference was fixed at the first year, there was a 4% increase from year-1 to year-2, but a 6% increase from year-1 to year-3. Using the second time point as the reference, depressive symptoms were 4% lower in year-1 compared to year-2 two, and 2% higher in year-3 than year-2. This flexibility in expressing change can be applied to specific research purpose and contexts.

### **23. Ordinal Category and Mixed Effects Proportional and Non-proportional Odds Models to go Beyond Binary yes/no Survey Items to Describe and Evaluate Program Impact on Teen Sexual Activity**

*Harry Piotrowski and Donald Hedeker*

Background: Program evaluations generally use binary items about sexual activity to measure impact on teen pregnancy: yes/no option to ever sexual intercourse, sex in past 3-months or use of condom. Purpose: We demonstrate the utility of a multiple category ordinal scale that represents graded responses of increasing health risk in mixed-effects longitudinal models that accommodate multiple random effects. Methods: Middle school cluster RCT: 14 schools, 1,776 enrolled in grade 6 completed five surveys (before-after intervention in grade 7 and 8 and at 12-month post follow-up). Study sample includes 1,718 students, 8,969 observations. Student indicates behaviors passed, behavior currently engaged in, and behaviors not currently engaged. Construction and ordinal logistic regression analysis of impact with SUPERMIX software are presented using the 9-stage Partner Physical Intimacy scale: no activity; holding hands; hugging/kissing; touching above/below waist; other, ever sexual intercourse or in past 3 months; condom/birth control. Results. Transition/escalation to risky behaviors is less often, delayed, with Intervention group. Impact of the program is observed at grades 7 and 9, and more often for boys and white student subgroups. Conclusion: Multiple category ordinal composite scales of progression of non-sexual and sexual behaviors provide longitudinal results on program impacts and implementation matching program components.

### **24. Potential Pitfalls of Applying Survey Weights when Modeling**

*Elizabeth Schofield and Yuelin Li*

Survey weights perform an important utility when a non-representative sample is to be used to estimate population means and frequencies. However, despite a general uneasiness among statisticians when applying such weights in regression and other modeling analysis, health researchers use them routinely and often indiscriminately, due in part to the integration of these weighting methods into mainstream statistical software and the belief amongst researchers that these are always superior to unweighted methods. We conducted a simulation study in R to demonstrate when applying complex survey weights was superior, inferior, and comparable to unweighted methods by calculating power, type I error, and estimate bias. In our simulations, unweighted parameter estimates performed comparably, with respect to bias and power, to weighted estimates when models conditioned on at least some sampling variables. Moreover, weighted models sometimes resulted in inflated type I error, sometimes as much as double the specified alpha. We considered scenarios where both the outcome model and the weighting model were slightly misspecified, to simulate more realistic situations, and the results were similar across scenarios. We conclude that weighted regression analysis may be inappropriate when modeling effects related to the over-sampling process and when the over-sampling process is not well-understood.

## **25. Fitting Ordinal Factor Analysis Models with Missing Data: A Comparison between Pairwise Deletion and Multiple Imputation**

*Dexin Shi, Taehun Lee, and Alberto Maydeu-Olivares*

This study compares two missing data procedures, pairwise deletion (PD; the default setting in Mplus) and multiple imputation (MI) in the context of ordinal factor analysis models. We examine which procedure, PD or MI, tends to show parameter estimates and model fit indices closer to those from analysis of the hypothetical complete data. The performance of PD and MI are compared under a wide range of conditions, including sample size, percent of missingness, and degree of model misfit. Results indicate that both PD and MI yield parameter estimates similar to those from analysis of complete data under conditions where the data are missing completely at random (MCAR). When the data are missing at random (MAR), the PD parameter estimates could be severely different from those obtained from the complete data analysis; given the percentage of missingness is low (less than 50%), the MI procedure could yield parameter estimates that are similar to the results using complete data. However, when applying the MI procedure, the fit indices (i.e., CFI, TLI, RMSEA, and WRMR) tend to yield estimates that suggested a worse fit than the counterparts which would have been obtained using complete data. Implications and recommendations for applied researchers are also provided.

## **26. The Relationship of Chronic Absenteeism and Middle School Engagement: An LCGA and Factor Analysis**

*Odelia Simon*

This study addresses a gap in the chronic absenteeism (being absent over 10% of the school year) literature, by evaluating trajectories of elementary school absenteeism and their relationship to eighth grade school engagement, when student attitudes generally shift. Using a national data sample (ECLS-K:1998) and a latent class growth analysis, this study identifies trajectories of elementary student absenteeism, and uses them to connect to middle school engagement, conceptualized as two latent factors of emotional and behavioral school engagement. Results indicate a four-class model, with high, low, increasing and decreasing trajectories. Sensitivity analyses confirmed the selection of this "cat's cradle" patterned model. Along with various predictors of these trajectories including race, socioeconomic status, mother's employment, and parental marital status, the LCGA was used to predict middle school engagement. While trajectories were predictive of both factors, they were more predictive of behavioral engagement, with the decreasing absenteeism class demonstrating the highest engagement, and the increasing absenteeism class demonstrating the lowest engagement. This suggests changes rather than stability in absenteeism patterns are the most powerful predictors of later school engagement, patterns an analysis of a single year or of the student's total chronic absenteeism would not reveal.



## **27. Optimal Priors For Use With Bayesian Regression When Estimating Oral Reading Fluency Slopes**

*Benjamin G. Solomon and Ole J. Forsberg*

Bayesian methods have received recent increased attention in educational research: a result of the recognized analytical advantages of using such techniques. Such methods are particularly amenable to applied decision-making. Both a strength and weakness of such models is that they require the specification of reasonable priors. Extending the work of Solomon and Forsberg (2017), this poster will summarize an ongoing experimental study addressing the bias, efficiency, and accuracy of different prior combinations when using Bayesian regression to make instructional decisions with Curriculum-Based Measurement progress monitoring data. Specifically, we approximate the situation of an interventionist comparing a student's estimated growth slope against a desired aimline of progress for reading fluency, using Bayesian regression to determine the probability that the student's growth exceeds that of the aimline. Results are based on the collected data of 102 2nd and 3rd graders. We review three different shape parameters to model error in slope (Normal, t-distributed, Asymmetric), three location parameters (uninformed, use of national norms or classroom-local norms), and compare all prior combinations to the current mainstay for decision-making: Ordinary-Least-Squares. Recommendations for both applied practice and research will be discussed.

## **28. Applying Time Series Modeling to Forecast Monthly Reports of Abuse, Neglect and/or Exploitation Involving an Adult in the State of South Carolina**

*Nelis Soto-Ramirez and Cynthia Flynn*

Time series modeling to predict reports related to maltreatment of vulnerable adults can be helpful for efficient early planning and resource allocation to handle a high volume of investigations. An autoregressive integrated moving average (ARIMA) time series analysis of monthly reports of adult abuse, neglect and/or exploitation (APS intakes) was conducted using intake data from the SC Child and Adult Protective Services System (CAPSS) between January 2014 and December 2017. The time series model was built according to the Box-Jenkins methodology consisting of three iterative steps: identification, estimation, and diagnostic checking. The coefficient of determination ( $R^2$ ), normalized Schwartz Bayesian Criterion (SBC), mean square error (MSE), and Q-test P value were used to evaluate the goodness-of-fit of constructed models. The most parsimonious model with the highest accuracy was applied to predict the expected monthly APS intakes from January 2018 to June 2018. The counts of APS intakes were transformed using a quartic root transformation to stabilize the variance. To get the forecast values in the original scales, the reverse transformation was calculated. Over 23,000 APS intakes accepted for investigation were identified over a period of four calendar years with an increase in the monthly median intake between 2014 (309) and 2017 (585). The best-fitted ARIMA model was identified as  $(1,1,0) \times (1,0,0)_{12}$  with the largest coefficient of determination ( $R^2=0.80$ ) and lowest SBC (-43.78) and MSE (0.016) values. Also, the residuals of the model showed non-significant autocorrelations (P Box-Ljung (Q) = 0.13). Major peaks were observed during June to July, and again a light peak for March, adequately capturing the pattern in the data. The optimum ARIMA model predicted a monthly APS intake of approximately 747 by June 2018, representing a 13% increase from December 2017 (n=660). ARIMA time series models are a valuable tool to allow forecasting of future reports of maltreatment of vulnerable adults with high accuracy and predict increasing APS intakes into the future. The model generated by this study may help in appropriate planning and resource allocation to handle reports of abuse, neglect and/or exploitation involving an adult reported to SC DSS.

## **29. Using ESEM to Generate Parenting Profiles and Explain Preschool Enrollment Decision: An application to Chile**

*Pamela Soto-Ramirez*

Early interventions at a preschool level are considered to be an important factor in combating social inequalities. Consequently, different policies have been put into practice in order to increase the supply of preschool facilities. Nevertheless, some parents choose to not enroll their children in preschool despite the sufficient supply of centers. Whereas most of the literature has focused on the effects of preschool attendance on several outcomes, we know very little about how this decision is being made. Using data from the Longitudinal Survey of Early Childhood (ELPI) held in Chile, this research examines the parent's decision of childhood enrollment. I use an exploratory confirmatory factor analysis (ECFA) approach to generate profiles that are related with parent's enrollment decision, and later I explain how each of these profiles are related with children's attendance to childcare by using regression analysis. The main results suggest that attendance to childcare is mostly explained by childcare proximity and by the necessity of working mothers. On the other hand, there seems to be a generalized lack of trust in childcare educational benefits among mothers. This research contributes to the understanding and the design of policies oriented to close the gap between supply and demand for preschool. In particular, whereas availability plays an important role in enrollment decisions, quality improvements and a better communication of the educational benefits of childcare are key in raising the demand for preschool.

## **30. Obtaining the Adjusted Relative Risk with Binary Outcomes Using Poisson Regression**

*James Uanhoro*

Education researchers often apply logistic regression to analysis of binary outcomes. A commonly reported outcome of such analysis is the odds ratio adjusted for other predictors. Unfortunately, education researchers sometimes interpret the odds ratio as the relative risk, which often leads to overstating the results. I present the application of Poisson regression to binary data as an alternative. Exponentiated coefficients from this model are consistent estimates of the adjusted relative risk when there are multiple predictors. However, the variance of binary data is less than its mean, such that the data could be described as under-dispersed, leading to overly large standard errors. Using Monte Carlo simulation, I study the capacity of quasi-Poisson models (Poisson with a dispersion parameter) and Poisson models with robust standard errors for efficient variance estimation, relative to the logistic model. I find that these alternatives perform comparably to the logistic model in terms of variance estimation. Given the ubiquity of multilevel data in education, I also study the capacity of generalized Poisson regression and Poisson with cluster-robust standard errors for efficient variance estimation of the adjusted relative risk in multilevel data.

### **31. A Supervised Data Mining Approach for Identifying Behavior Sequences Related to Specific Outcomes**

*Christopher J. Urban, Matthew L. Bernacki, Kathleen M Gates, Abigail T. Panter, Kelly A. Hogan, and Jeffrey A. Greene*

Accurately predicting which students are likely to perform poorly in the classroom as well as understanding behavioral differences between high- and low-performing students are important first steps toward developing interventions to assist low-performing students. Online learning management systems (LMS) frequently track information including the date and number of times students access particular learning objects. This often underutilized data provides a rich and fine-grained source of information about student learning behaviors. Importantly, LMS data can uniquely provide information on the ordering of learning events in real-world settings. In this study, we utilize data mining to examine the frequency and ordering of behaviors related to passing the course. We demonstrate these techniques using data obtained from a LMS website at a public university. First, we use feed-forward logistic regression models to predict which students will pass the course using their frequencies of interaction with various learning objects. Next, we employ differential sequence mining (Kinnebrew, Loretz, & Biswas, 2013), an algorithm that combines various sequence mining techniques, to identify differentially frequent behavior patterns between students who pass and those who fail the course.

### **32. Identifying a Typology of STEM-Focused High Schools: A Latent Class Analysis of HSLs:2009**

*Luronne Vaval and Alex J. Bowers*

Prior research suggests that the odds of pursuing a science, technology, engineering, and mathematics (STEM) degree are higher for students who attend STEM-focused high schools than student who attend traditional high schools (Bottia, Stearns, Mickelson, Moller, & Parker, 2015). STEM-focused high schools are specialty high schools with a primary focus on STEM subjects. Many of the characteristics thought to be unique to STEM-focused high schools may be found, in part, in traditional high schools. Identifying the characteristics attributable to the success of STEM-focused high schools can later serve as exemplars of successful STEM education for districts seeking to improve the quality of STEM teaching and learning (NRC, 2011). The purpose of this study is to examine a typology of STEM focused high schools from a large nationally representative sample using the three-step latent class analysis (LCA) approach. Our results show a significantly different typology of high schools based on their orientation towards STEM. We identified four types of high school: STEM-Focused, Comprehensive, Achievement-Focused, and Informal STEM. Implications are given for further analyses that consider the effects of school demographics and opportunities for students from underrepresented groups in STEM-focused high schools.

### **33. The Nonparametric Bootstrap as an Alternative for the Estimation of Mixture Models with External Variables**

*Marcus Waldman and Katherine Masyn*

Although superior to existing latent class regression and other multiple-step distal outcome procedures, simulation studies reveal that the Bakk & Kuhas (2017) two-step procedure continues to result in biased point estimates and poor coverage when sample sizes are small and class separation is low. The present study investigates the source of this bias and focuses on the underlying normality assumptions and asymptotic approximations made in standard maximum likelihood (ML) estimators. Specifically, we evaluate if the likelihood is poorly approximated by a normal distribution in small sample sizes and low class-separation settings. Further, we study whether departures any departures from normality corresponds to increases in the bias of the structural parameters. Finally, we propose an alternative, nonparametric two-step procedure that employs the bootstrap to conduct inference when employing latent class analysis with external variables. Through a simulation study, we compare the bias, efficiency, and coverage from the proposed bootstrap procedure to results obtained from Bakk & Kuha's (2017).

### **34. Examining Growth Patterns and Rate of Change in the Development of Reading Skills**

*Raffaella Wolf and Alison Mitchell*

Providing equal educational opportunities for all students is a necessity to ensure academic success for individual students. English Language Learners (ELLs) represent one of the fastest-growing groups among public schools in this nation. This study examines student growth patterns and rate of change throughout one academic school year in reading achievement between ELLs and non-ELLs in four skills; reading comprehension, word recognition, vocabulary knowledge, and syntactic knowledge using a computer adaptive assessment at three grade levels (third, fourth, fifth). Multilevel Linear Modeling estimates indicated that the gap in performance between ELLs and non-ELLs was smallest on the reading comprehension task across all three grades suggesting that both ELLs and non-ELLs demonstrate similar rates of growth on this complex skill.

### **35. Using Security Questions to Link Participants in Web-Based Longitudinal Studies**

*Shu Xu, Anthea Chan, and Michael F. Lorber*

Web-based anonymous data collection poses difficulties in linking participants over time in longitudinal studies, regardless of advantages including improved data quality, protected privacy, and higher time-and-cost efficiency, compared to paper-based data collection. To overcome this difficulty, the authors propose a security question linking (SEEK) algorithm to assemble the responses of same participants over time in longitudinal web-based surveys. The SEEK algorithm is composed of four steps, (1) data management and standardization, (2) many-to-many matching, (3) fuzzy matching, and (4) eyeball matching and verification. The algorithm is demonstrated in SAS with two adolescent samples from a longitudinal web-based survey on teen dating violence. After the initial assessment in a lab visit, participants of two samples were repeatedly measured 3 months later (Sample 1,  $n = 60$ ) and 3 times at one-month intervals (Sample 2,  $n = 140$ ), respectively. Demographics and responses to nine security questions were used as key variables to linking responses in the lab and web-based follow-up assessments. In Sample 1, 59 completed the 3-month follow up. In Sample 2, 123, 119, and 108 participants completed the first three monthly web follow-up assessments, respectively. The rate of success match is 100% in Sample 1, and 95% in Sample 2. To quantify the confidence in the data quality of successfully matched pairs, we report the mean and standard deviation of the number of matched security questions. In addition, we report the rank order and counts of the mismatched components in key variables. Results indicate that the SEEK algorithm provides a feasible and reliable solution to link responses in web-based longitudinal studies. Future directions include selection of optimal security questions in specific research content, calibrated judgment on matching criteria and improved study design.

### **36. RJMCMC for LGMM**

*Yuzhu Yang and Sarah Depaoli*

Within the context of latent growth mixture models, class separation is usually characterized as degree of similarity or difference among the growth trajectories for multiple latent classes. Poor class separation may cause estimation issues in mixture models. Class separation has been studied via frequentist methods (see e.g., Tueller&Lubke, 2010; Nylund et al, 2007), as well as the Bayesian framework (see e.g., Depaoli, 2013). In this study, we extend the examination of the impact of class separation to Bayesian non-parametric methods. Specifically, we investigate how the Dirichlet Process (DP) method recovers the number of latent classes and corresponding growth parameters under different levels of class separation and sample sizes. In addition, we also include the frequentist and Bayesian estimation methods as comparisons. We conducted a simulation study that examined three levels of class separation in terms of multivariate Mahalanobis distance (MD) values (MD=1, MD=2, and MD=3) with two levels of sample sizes ( $n=200$  and  $n=600$ ) for a 3-class growth mixture model. The simulation conditions are fully crossed with four types of estimation methods, which are: 1) DP, 2) maximum likelihood, 3) Bayesian estimation with informative priors, and 4) Bayesian estimation with diffuse priors. We will report on the major findings related to the performance of the DP method as compared to the more traditional use of frequentist and Bayesian methods. Implications and recommendations for applied researchers are also discussed.

### **37. Class Separation for Latent Growth Mixture Modeling via Dirichlet Process**

*Yuzhu Yang and Sarah Depaoli*

Within the context of latent growth mixture models, class separation is usually characterized as degree of similarity or difference among the growth trajectories for multiple latent classes. Poor class separation may cause estimation issues in mixture models. Class separation has been studied via frequentist methods (see e.g., Tueller&Lubke, 2010; Nylund et al, 2007), as well as the Bayesian framework (see e.g., Depaoli, 2013). In this study, we extend the examination of the impact of class separation to Bayesian non-parametric methods. Specifically, we investigate how the Dirichlet Process (DP) method recovers the number of latent classes and corresponding growth parameters under different levels of class separation and sample sizes. In addition, we also include the frequentist and Bayesian estimation methods as comparisons. We conducted a simulation study that examined three levels of class separation in terms of multivariate Mahalanobis distance (MD) values (MD=1, MD=2, and MD=3) with two levels of sample sizes (n=200 and n=600) for a 3-class growth mixture model. The simulation conditions are fully crossed with four types of estimation methods, which are: 1) DP, 2) maximum likelihood, 3) Bayesian estimation with informative priors, and 4) Bayesian estimation with diffuse priors. We will report on the major findings related to the performance of the DP method as compared to the more traditional use of frequentist and Bayesian methods. Implications and recommendations for applied researchers are also discussed.

### **38. A Weight-Function Model for Publication Bias Based on Effect Sizes**

*Nicole Zelinsky and Jack Vevea*

As the amount of research expands, researchers use literature reviews and meta-analyses to summarize findings, but some studies may be unpublished and end up in a file drawer. Publication bias occurs if the excluded articles differ from the included articles in important ways, such as the published studies demonstrating larger effect sizes than unpublished studies. This bias in the literature then carries over to meta-analyses, resulting in collections of studies with inflated effect sizes. Researchers have developed statistical methods to detect and model publication bias in a meta-analysis, and although homogeneity is an assumption of most of those methods, a meta-analysis may not be homogeneous. If a meta-analysis is heterogeneous, a weight-function selection model can be used to model the effect size estimates in the presence of publication bias (Vevea & Hedges, 1995). The weight-function model assumes that changes in the likelihood of publication occur at psychologically important p-values, and the model adjusts the meta-analysis estimates appropriately. However, some studies do not contain p-values; for example, researchers tend to analyze single-case designs (SCDs) visually or with descriptive statistics instead of significance tests (Shadish & Sullivan, 2011). Additionally, Shadish, Zelinsky, Vevea, and Kratochwill (2016) found that SCD researchers were less likely to publish studies with smaller effect sizes than larger effect sizes, an example of publication bias. Although the traditional methods work for meta-analyses that include SCD research, a more flexible weight-function selection model would more appropriately capture the effect-size estimate in situations without homogeneity. However, given the lack of SCD researchers' use of p-values, it would be more appropriate to employ a weight-function model that specifies a selection process based on effect magnitude. There is no current weight-function selection model to adjust parameters based on effect sizes instead of p-values. The present research presents a model to detect and adjust for publication bias based on effect sizes instead of p-values. This model will allow researchers to gain benefits of flexibility not present in deterministic publication bias models. We include a simulation demonstrating that the model works when assumptions are met and illustrate the model with an example.

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# DATIC Workshops- June 2018

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## Mixture Modeling

Instructor: *Dr. Eric Loken*

June 4th-6th, 2018

This 3-day mixture modeling workshop will survey techniques for exploring heterogeneous latent structure in data. We will begin by defining a variety of mixture models. The main focus will be on latent class analysis (LCA) and latent profile analysis (LPA), with applications in education, health, and the social sciences. Additional models will include mixture regression models, mixture IRT, k-means clustering, and growth mixture models for longitudinal data. The course will emphasize hands-on work by participants, who will also be encouraged to make connections to their own data, learning to execute many of these models in R. Particular attention will be paid to issues that arise in applied settings including model assumptions, parameter estimation, and interpretation.

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## Introduction to Data Analysis in R

Instructor: *Dr. Randi L. Garcia*

Session 1: June 7<sup>th</sup>-8<sup>th</sup>, 2018

Session 2: June 21<sup>st</sup>-22<sup>nd</sup>, 2018

Are you curious about using R for data analysis? Have you been thinking about making the switch to R, but don't know where to start? This two-day workshop is the perfect quick start guide to analyzing your data with R. We will cover the fundamentals of data analysis in R with a special focus on translating your existing knowledge and skills from other software (e.g., SPSS) into R. The goal of this workshop is to develop proficiency in R for data preparation and preliminary data analysis. We will build confidence in importing data from different sources into RStudio and getting that data ready for any advanced technique you might then employ. Among the topics to be covered are intro to the RStudio environment, packages, and RMarkdown, data manipulation, data visualization, correlations, reliability tests, basic inference tests, ANOVA, linear regression, Exploratory Factor Analysis (EFA), Confirmatory Factor Analysis (CFA), and more. Instruction on the specific statistics and statistical models will be minimal to zero. It is assumed that you already know how to do these analyses, but you want to see how to do them in R. You do not need to be registered for any other DATIC workshops to enroll in the 2 day Introduction to Data Analysis in R workshop.

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## Multilevel Modeling using R

Instructors: *Drs. D. Betsy McCoach & Randi Garcia*

June 11<sup>th</sup>-15<sup>th</sup>, 2018

This workshop covers the basics and applications of multilevel modeling with extensions to more complex designs. Participants will learn how to analyze both organizational and longitudinal (mostly growth curve) data using multilevel modeling and to interpret the results from their analyses. Although the workshop does not require any prior knowledge or experience with multilevel modeling, participants are expected to have a working knowledge of multiple regression. The emphasis will be practical with minimal emphasis on statistical theory, but those seeking more statistical information can arrange an individualized session with the instructors. All analyses will be demonstrated using R. Instruction will consist of lectures, computer demonstrations of data analyses, and hands-on opportunities to analyze practice data sets using R. The workshop emphasizes practical applications and places minimal emphasis on statistical theory. No prior familiarity with R is required, but if you have never used R and want to gain a general proficiency working with data in R, we encourage you to take the two-day DATIC Intro to R and RStudio workshop held on Thursday, June 7, through Friday, June 8, 2018.

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## Dyadic Data Analysis with R

Instructor: *Drs. Randi L. Garcia and David A. Kenny*

June 25<sup>th</sup>-19<sup>th</sup>, 2018

The Dyadic Data Analysis workshop focuses on the analysis of dyadic data when both members of a dyad are measured on the same variables. All analyses will use multilevel modeling in R via the RStudio graphical interface. Participants will learn how to analyze dyadic data and to interpret the results from their analyses. Among the topics to be covered are the vocabulary of dyadic analysis, non-independence, data structures, and the Actor-Partner Interdependence Model. We also discuss mediation and moderation of dyadic effects. On day 4, participants choose from one of two break-out sessions: 1) the analysis of over-time dyadic data (e.g., growth curve models) or 2) dyadic data analysis with SEM using the lavaan R package (e.g., Actor-Partner Interdependence Model and Common Fate Model). The discussion of over-time data is limited to one day so the workshop should not be construed as workshop on longitudinal dyadic analysis. Participants should have a working knowledge of multiple regression. No prior familiarity with R is required, but if you have never used R and want to gain a general proficiency working with data in R, we encourage you to take the two-day DATIC Intro to R and RStudio workshop.

**For more information, visit our website: [www.datic.uconn.edu](http://www.datic.uconn.edu)**

## Call for proposals: 2019 Modern Modeling Methods (M<sup>3</sup>) conference

The Modern Modeling Methods (M<sup>3</sup>) conference is an interdisciplinary conference designed to showcase the latest modeling methods and to present research related to these methodologies. The 9th annual M<sup>3</sup> conference will be held May 20<sup>nd</sup>-23<sup>rd</sup>, 2019 at the University of Connecticut. Keynote speakers for the 2019 conference include Dr. Bengt Muthen.

Submissions for the 2019 conference are due 2/1/19. We welcome both methodological research papers and papers that illustrate novel applications of methodological techniques in the area of modeling, broadly defined. Papers related to multilevel modeling, structural equation modeling, mixture modeling, longitudinal modeling, and item response theory are especially encouraged. Given the interdisciplinary focus of the conference, it is completely acceptable to present papers that have been published or presented elsewhere. Presenters may select the length of the session that they prefer: 30 minutes, 60 minutes, or 90 minutes. We also welcome proposals for multi-paper symposia on thematically grouped topics. Generally, symposia sessions are 90 minutes in length. We are also soliciting proposals for the poster. Students are also encouraged to submit proposals, especially for the poster session.

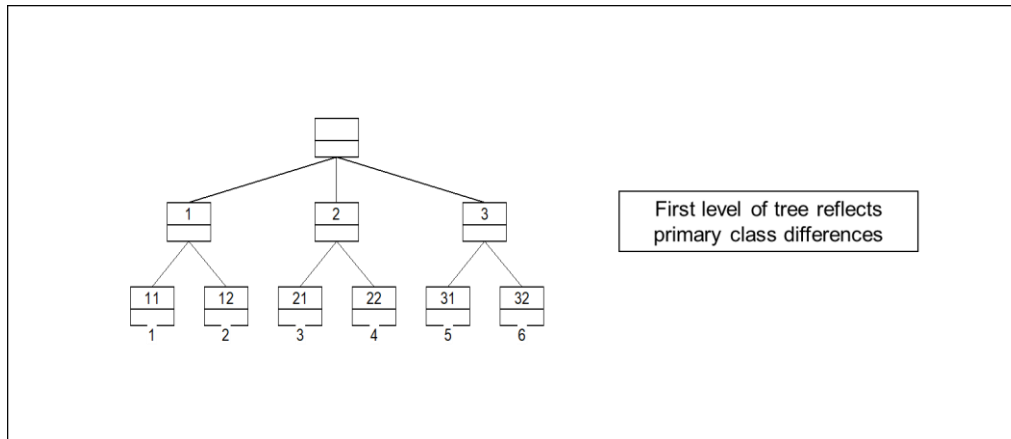
Conference proposals for the Modern Modeling Methods conference may fall into one (or more) of four categories: Methodological Innovation, Methodological Application, Methodological Illustration, or Methodological Evaluation. Methodological Innovation proposals introduce a new technique. Methodological Evaluation proposals present the results of empirical research evaluating a methodology. Most often, these will involve simulation studies. Methodological Application proposals present the methods and results of a real research study in which the technique was used. Methodological Illustration proposals provide a pedagogical illustration of when and how to use the technique; these papers are designed to help the audience be able to implement the technique themselves.

There are three different types of presentations: Paper sessions (in which authors submit a paper), Symposia (in which a group of authors submit a set of related talks/papers), and posters. Methodological Research paper proposals should be no longer than 1000 words and should include purpose, background, methods, results, discussion, and significance. Methodological Illustration paper proposals should be no longer than 1,000 words and should include a description of the methodology to be illustrated as well as an outline of the paper/talk. Proposals for symposia should include titles, authors, an abstract for the symposium, and brief descriptions/abstracts for all of the paper presentations within the symposium. Symposium proposals may be longer than 1000 words if needed, but they should be less than 2000 words. Proposals for the poster session need only submit an abstract: the 1000 word proposal is *not* required for poster session proposals.

Proposals for the 2019 conference are due February 1<sup>st</sup>, 2019. Notifications of presentation status will be emailed by February 19<sup>th</sup>, 2019. For more information about the conference and to submit conference proposals, please visit <http://www.modeling.uconn.edu/>.



**M3 Attendees:  
Journey into the Future of Latent Class (LC) Modeling!**



**Latent Class Trees – A New Paradigm for Latent Class Modeling**

## Don't Miss These Presentations!

**Session 5B: Wednesday, May 23 from 9:15-10:15**

<i>An improved latent class (LC) paradigm to obtain meaningful segments in the presence of scale confounds: Scale Adjusted Latent Class (SALC) Tree modeling</i>	Jay Magidson
<i>Using Latent Class Trees to Classify New Students in an Adaptive Assessment Progression</i>	John P. Madura

**Latent GOLD® is the #1 package for latent class modeling**

It has both a point and click menu (GUI), and a powerful, flexible syntax language to estimate latent class, latent trait and extended models based on variables of different scale types including continuous, ordinal, nominal, and count.