**ICPSR Summer Program in Quantitative Methods of Social Research**

**Level, Change, and Acceleration: Modeling Correlated Change in Longitudinal Data and Intensive Repeated Measures Design**

**Instructor:** Pascal R. Deboeck, Ph.D.

**Location:** Gardner Commons, University of Utah campus (Salt Lake City, UT)

**Dates:** June 24-28, 2019

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**Course Description**

An ever-increasing number of models are available for the modeling of repeated observations on the same individuals, families, and groups. While theories often express ideas about correlated changes between constructs, matching theories about growth and change to statistical models can be challenging. This workshop will introduce derivatives -- level, change, and acceleration. This framework will provide a basis for articulating theories of change, as well as a framework for understanding a wide variety of change models. A variety of foundational models for longitudinal data will be discussed using this framework. These more common models will then be used to build models for intensive repeated measures designs (e.g., diary data, ecological momentary assessments). This course will provide a conceptual understanding of topics using lecture, reference code through demonstrations, and hands-on practice with sample data.

**Software Requirements:** Lectures and exercises will rely on R, so that course tools and code are available to all participants. A concise introduction to R included as part of the course.

**Prerequisites:** Prior experience with a graduate-level introductory statistics course (including regression models) and some exposure to longitudinal data is strongly recommended. It is not necessary to have prior exposure to R, SEM, or MLM, although participants with any exposure to one or more of these topics can expect to take more from the course. Introductions to core concepts in R, SEM, and MLM are included as part of the course, but not in sufficient depth to constitute a good background in these topics.
**Schedule:** The schedule times are approximate.

**Software and Conceptual Foundations**
Monday, June 24, 2019: 9:00am-12:30pm; This course section will include:
1) Introductions and overview of course.
2) A brief introduction to key Structural Equation Modeling (SEM) and Multilevel Modeling (MLM) concepts building from regression. This will include an introduction to SEM diagrams and how they relate to regression, and an introduction to random effects in MLM.
3) A very brief introduction to R, including reading data and how to use functions.

Monday, June 24, 2019: 1:30pm-5:00pm; This course section will include:
1) Introduction to the R package lavaan, a package for SEM.
2) Introduction to the R package nlme, a package for MLM.
3) Hands-on practice programming an SEM model and an MLM model.
4) A discussion about how change is conceptualized, with an introduction to the idea of derivatives (level, velocity, and acceleration)

**Longitudinal/Panel Data (relatively few repeated observations)**
Tuesday, June 25, 2019: 9:00am-12:30pm; This course section will include:
1) Introduction to foundational longitudinal models. Models of growth including latent growth curve models, and the equivalent model in MLM, will be introduced.
2) Hands-on practice programming a growth model.

Tuesday, June 25, 2019: 1:30pm-5:00pm; This course section will include:
1) An introduction to Cross-Lagged Panel Models, and other models where observations are modeled using prior observations.
2) Hands-on practice programming a cross-lagged panel model with random intercepts.

Wednesday, June 26, 2019: 9:00am-12:30pm; This course section will include:
1) A introduction to Latent Difference Scores.
2) Hands-on practice programming a latent difference score model.

**Intensive Repeated Measures (e.g., diary data, ecological momentary assessments)**
Wednesday, June 26, 2019: 1:30pm-5:00pm; This course section will include:
1) A conceptual introduction to models using level, change and acceleration for intensive data such as diary data and ecological momentary assessments. Such data are often characterized by non-linear changes over time. Focus will be placed on a second-order differential equation model.

Thursday, June 27, 2019: 9:00am-12:30pm; This course section will include:
1) Methods for estimating derivatives (e.g., Generalize Local Linear Approximation, Generalized Orthogonal Local Derivative Estimates)
2) Hands-on practice estimating derivatives from time series.

Thursday, June 27, 2019: 1:30pm-5:00pm; This course section will include:
1) Modeling relations between derivative estimates using regression, MLM and SEM.
2) Hands-on practice fitting differential equation models.

Friday, June 28, 2019: 9:00am-12:30pm; This course section will include:
1) An introduction to modeling change with Latent Differential Equations.
2) Practice fitting differential equations using SEM.

**Individualized Consultation (availability will depend on demand)**
Friday, June 28, 2019: 1:30pm-5:00pm