Multilevel Modeling

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Course Outline

(approximately by day)

0. Before Getting Started - A Brief Introduction to Stata

(please study this Section 0, if need be, before the course)

- **What is Stata?**
  - **Resources for working with Stata**
  - **Why use Stata?**

- **A data set to illustrate some data relevant management capabilities of Stata**
  - **The Stata working windows**
  - **Exploring a data set**
  - **Examining variables**
  - **Putting order into a data file**
  - **Assigning labels and variable names**
  - **Dealing with missing values – a first essential step**
  - **Modifying existing and creating new variables**
  - **Transforming variables**
  - **A general approach to variable transformation**
  - **Getting help.**

Day 1:

1. **Where multilevel modeling begins: Fitting single-level regression models Stata**
   - **Data set and research question**
   - **Preliminary analyses**
   - **Single-level regression analysis with Stata**
     - **Plotting residuals against predictors**
     - **Plotting residuals against fitted (predicted) values**
     - **Plotting standardized residuals.**

2. **Why do we need multilevel and mixed models?**
   - **What is multilevel modeling, why can't we do without it, and how come aggregation and disaggregation do not do the job?**
     - **Examples of nested data and the hallmark of multilevel modeling**
     - **Another important instance of multilevel modeling**
     - **Aggregation and disaggregation of variable scores**
     - **Analytic benefits of multilevel modeling.**
   - **The beginnings of multilevel modeling – why what we already know about regression analysis will be so useful**
     - **Multilevel models as sets of regression equations**
     - **An illustrative (and motivating) example of multilevel modeling.**

Day 2:

1. **The intra-class correlation coefficient and its estimation**
   - **The fully unconditional two-level model and definition of the intraclass correlation coefficient (ICC)**
   - **Point and interval estimation of the ICC using Stata**

2. **How many levels? – Proportion of third level variance and its evaluation**
   - **Proportion third level variance**

- **The fully unconditional three-level model**
- **Point and interval estimation of proportion third level variance using Stata.**

3. Robust modeling of lower-level variable relationships in the presence of clustering

Subsection 1 (Day 2):

- **What is robust modeling in the presence of nesting effects?**
- **A brief intro to structural equation modeling – a useful general framework also for multilevel modeling**

Subsection 2 (Day 3):

- **Robust modeling of hierarchical (multilevel) data using Stata**
- **Multivariate multiple regression with hierarchical data, missing data, and violation of missing at random.**

<u>Day 3</u> (continued):

1. Mixed effects models (mixed models)

- **What are mixed models, what are they made of, and why are they so useful?**
  - **An illustration of the difference between fixed and random effects**
  - **Examples of mixed modeling frameworks**
- **Mixed models with continuous response variables.**
- **Random intercept models**
  - **Fitting a random intercept model with Stata**
  - **Model adequacy evaluation**
  - **Between- and within-estimators and when to use which**
- **Random regression models**
  - **An instructive example and the restricted maximum likelihood (REML) method**
  - **Random intercept and slope model**
  - **Multiple random slopes**
  - **Fixed effects, random effects, and total effects**

Day 4:

1. **Numerical issues and difficulties when fitting multilevel models**
2. **Nested levels (Stata's nomenclature)**
   - **unconditional three-level mixed models**
   - **conditional three-level models**
   - **four-level models**
3. **Mixed models with discrete responses**
   - **Why do we need these models?**
   - **A few important statistical facts**
   - **The generalized linear model (GLIM)**
     - **Random intercept models with discrete outcomes**
     - **Random regression models with discrete outcomes**
   - **Model choice, and its relevance for multilevel discrete outcome models.**

Day 5:

1. **Crossed effects multilevel models**
   - **What are crossed effects?**
   - **Multilevel modeling with crossed effects**
   - **Complex multilevel models and their fitting and result interpretation**

2. **Longitudinal multilevel modeling**
   - **Introduction**
   - **Multilevel modeling of longitudinal data**
   - **Using Stata to fit unconditional and conditional growth curve models (cross-sectional time series).**

Day 6:

1. **Extensions of multilevel models – latent variable modeling as a useful general framework to pursue also multilevel modeling**

2. **Longitudinal data analysis – an „alternative“ approach via latent variable modeling.**

3. **Latent class analysis (market segmentation) as another „alternative“ to multilevel modeling.**

4. What we could not cover in this course

5. Conclusion and outlook.

Lecture notes volume:

Raykov, T. (2020). ***A course in multilevel modeling*****. Lecture notes. Michigan State University, East Lansing, Michigan, USA.**