Integrative Analysis of Longitudinal Studies on Aging

Multivariate Latent Growth Curve Model

IALSA workshop Portland 2015

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University of Victoria

Multivariate Growth Models

Univariate LCM

- Repeated measures for a single outcome
- e.g. How does memory change with time?

Multivariate LCM

- Repeated measures of multiple outcomes for each person across time
- Association between selected developmental processes
- e.g. How is the trajectory of physical capability (ex: grip strength) related to the trajectory of memory ?

Multivariate Growth Models

1. Association between the intercepts (Between Person (BP) relation)
   - Is the level (usually initial level) of grip strength related to the level of memory?
2. Association between the slopes (BP relation)
   - Is the amount of change in grip strength related to the amount of change in memory?
3. Association between occasion-specific residuals (WP relation)
   - After accounting for intra-individual change in grip strength and memory, are occasion-specific residuals of grip strength related to occasion-specific residuals of memory?

In preparation for this workshop

We asked you all to:

- Read several papers
- Prepare data in specific format
- Run several input files using Mplus

Let's review Mplus syntax for univariate models just in case you feel like her….

Univariate Growth Models
Mplus code

```
TITLE:….;
DATA:….;
VARIABLE: NAMES ARE…..;

USEVAR ARE   time1-time5 p1-p5 Bage;   ! Name variables to be used in analysis
                                        (variable p here is the outcome)

ANALYSIS: TYPE = RANDOM;

MODEL:  ip sp | p1-p5 AT time1-time5;      ! Linear growth model for outcome p

          ip sp ON Bage;                   ! Intercept and slope regressed on
                                           age at study entry

         p1-p5 (res_p);                    ! Residual covariances constrained
                                             to be equal over time
```

Multivariate Growth Models code

```
USEVAR ARE   time1-time5 p1-p5  c1-c5  Bage;

ANALYSIS: TYPE = RANDOM;

MODEL:  ip sp | p1-p5 AT time1-time5;        ! Linear growth model for 1st outcome
         ic sc | c1-c5 AT time1-time5;       ! Linear growth model for 2nd. outcome


        ip sp ic sc ON Bage;                 ! Intercepts and slopes of both outcomes
                                             regressed on age at study entry

       p1-p5 (res_p);                        ! Residual variances constrained
                                             to be equal over time
       c1-c5 (res_c);
  p1-p5 pwith c1-c5 (res_cov);               ! Paired covariances constrained
                                             to be equal over time
    ip ic sp sc with ip ic sp sc ;           ! Covariances between latent variables
                                             (DEFAULT)
```

Alternative model:

Another possible formulation is the Directional Multivariate Growth Curve Model

- Intercept ⟶ Intercept
- Slope ⟶ Slope
- Occasion-specific residual ⟶ Occasion-specific residual
- Simple alteration Mplus syntax

TVC vs. Multivariate Models

TVC

- One growth curve
- TVC fluctuates
- Regressions
- Focus on occasion-specific residuals

Multivariate

- Two (or more) growth curves
- TVC changes
- Covariances
- Focus on associations between intercepts, slopes, and occasion-specific residuals

Suggested Readings

- Bollen, K.A. & Curran, P.J. (2006). *Latent curve models. A structural equation perspective.* Hoboken, NJ: John Wiley & Sons. (Chapter 7)

- Hofer, S. M., Gray, K.M., Piccinin, A. M., Mackinnon, A., Bontempo, D.E., Einfeld, S.L., Hoffman, L., Parmenter, T. & Tonge, B.J. (2009). Correlated and coupled within-person change in emotional and behavior disturbance in individuals with intellectual disability: Results from the Australian Child to Adult Development (ACAD) Study. *American Journal on Intellectual and Developmental Disabilities, 114(5),* 307-321.