

## 8<sup>th</sup> GESIS Summer School in Survey Methodology Cologne, August 2019

### Syllabus for Short Course A: "Using Mplus for Latent-Variable Modeling: An Introduction"

Instructors: Dr. Matthias Bluemke  
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Date: 01.-02. August 2019  
Time: 09:00-13:00, 14:00-16:00  
Course starts Thursday morning at 09:00

#### About the Instructors:

*Matthias Bluemke* is a senior researcher at the GESIS – Leibniz-Institute for the Social Sciences. He studied psychology at the Universities of Trier and Heidelberg, and earned his doctoral degree in 2006. He also obtained a master degree in medical biometry/statistics. In his research and service at GESIS, he is concerned with the validation of items and construction of questionnaires for social surveys. His research interests include methodological challenges, such as between-group equivalence of measurement models, as well as substantive research questions with regard to basic human traits, values, and cognition including psychological resources, and behavior-in-context.

*Ai Miyamoto* is a postdoctoral researcher in the team "Scale Development and Documentation" at GESIS – Leibniz-Institute for the Social Sciences. She studied psychology at the University of Victoria in B.C., Canada. She also earned her master degree (M.Sc.) at LMU, and her doctoral degree in psychology at the University of Bamberg. During her Ph.D., she investigated the motivation-achievement paradox of immigrant students in Germany. Her research involves the applications of measurement invariance testing and multi-group latent model approach in order to examine the interplay between cognitive and non-cognitive skills in predicting various learning outcomes from a longitudinal perspective.

*Clemens Lechner* is the head of the team "Scale Development and Documentation" in the Department of Survey Design and Methodology at GESIS – Leibniz-Institute for the Social Sciences. He graduated in psychology with a minor in sociology from the University of Jena (2005-2011) and earned his doctoral degree in developmental psychology at Jena in 2014. He was a postdoctoral fellow in the international "Pathways to Adulthood" program, working at the Center for Applied Developmental Science in Jena. His research addresses a broad range of substantive and methodological issues related to the measurement, life-span development, and consequences of individual differences in cognitive ability, personality, and values.

#### Selected Publications:

- Bluemke, M., Jong, J., Grevenstein, D., Mikloušić, I., & Halberstadt, J. (2016). Measuring cross-cultural supernatural beliefs with self- and peer-reports. *PLoS ONE* 11(10): e0164291. (<https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0164291>)
- Grevenstein, D., & Bluemke, M. (2015). Can the Big Five explain the criterion validity of Sense of Coherence for mental health, life satisfaction, and personal distress? *Personality and Individual Differences*, 77, 106–111. (<https://www.sciencedirect.com/science/article/pii/S0191886914007818>)

- Lechner, C. M., Danner, D., & Rammstedt, B. (2017). How is personality related to intelligence and achievement? A replication and extension of Borghans et al. and Salkever. *Personality and Individual Differences*, 111, 86–91. (<https://www.sciencedirect.com/science/article/pii/S0191886917300417>)
- Lechner, C. M., Sortheix, F. M., Göllner, R., & Salmela-Aro, K. (2017). The development of work values during the transition to adulthood: A two-country study. *Journal of Vocational Behavior*, 99, 52–65. (<https://www.sciencedirect.com/science/article/abs/pii/S000187911630104X>)
- Miyamoto, A., Pfof, M., & Artelt, C. (2018). Reciprocal relations between intrinsic reading motivation and reading competence: A comparison between native and immigrant students in Germany. *Journal of Research in Reading*, 41, 176–196. (<https://onlinelibrary.wiley.com/doi/abs/10.1111/1467-9817.12113>)
- Miyamoto, A., Seuring, J., & Kristen, C. (accepted). Immigrant students' achievements in light of their educational aspirations and academic motivation. *Journal of Ethnic and Migration Studies*.

## Short Course Description:

This short course introduces the statistical software Mplus and demonstrates the basic programming skills for analyzing multivariate statistical problems, such as structural equation models (SEM) with Mplus. Mplus is one of the most widely used software packages for analyzing such latent variable models. The main objective of the course is to understand the basic features of Mplus, the syntax of its code, and the appropriate work flow. Participants will learn how to prepare and load their data, become familiar with the structure of Mplus input and output files and learn how to write Mplus syntax of simple and more complex latent variable models. Rather than introducing specific statistical models, the course will focus on the more general task of handling the Mplus software and equip participants with the skills needed to implement their own statistical models. The participants are expected to be familiar with the general idea of statistical analysis, regression models, and sound knowledge about factor analysis. Basic knowledge about latent variable modeling and structural equation modeling is helpful. Aspects such as specifying models, choosing appropriate estimation methods, and handling missing data will be covered.

## Keywords:

Mplus, statistical software, data analysis, latent variable modeling, structural equation modeling

## Course Prerequisites:

- Good knowledge of basic uni- and multivariate statistics (especially regression and factor analysis);
- At least basic understanding of latent variables and structural equation modeling (SEM);
- No previous experience with Mplus required.

## Target Group:

Participants will find the course useful if:

- they want to use latent variables or apply structural equation modeling (SEM);
- they are interested in extending their technical/programming skills and are curious about a powerful statistical software;
- they attend the course "Introduction to Structural Equation Modeling" in week 1 of the summer school.

## Course and Learning Objectives:

By the end of the course participants will:

- know how to prepare data for Mplus analysis and/or use Mplus directly from Stata or R;
- be able to understand the Mplus syntax and write Mplus code for basic and more advanced (latent variable) models;
- be able to interpret Mplus output for typical latent-variable models;
- be able to translate fundamental statistical aspects of SEM into Mplus code.

## Organizational Structure of the Course:

This short course consists of about 6 hours of instruction per day. The course work is split into lectures and exercises. Special attention is given to the hands-on training. The instructors will be available for individual consultation during the exercises and after the lecture.

## Software and Hardware Requirements:

None. GESIS will provide participants with access to soft- and hardware.

## Long Course Description:

This course teaches you how to use the statistical software Mplus. Mplus is a code-based software that allows estimating latent variable models such as basic confirmatory factor analyses or more complex multi-group structural equation models. We start with a broad overview of the general syntactical elements of Mplus code. We devote some time to the appropriate work flow of preparing your data and transferring them into an Mplus-compatible file format, and we discuss typical obstacles. On the first day, we will learn how to program Mplus to analyze first latent variable models (e.g., latent variable regression models, also called measurement models, such as found in confirmatory factor analysis). The second day is reserved for more advanced models, such as longitudinal models, models with multi-group comparison, and constrained models with freed or fixed parameters or correlated errors. Furthermore, we will present the Mplus-Diagrammer. This short course is an applied course on the software and you are more than welcome to bring your own data and research questions along. Please let us know in advance by emailing your questions and problems, so we might be able to cover them in class. This course will not go into detail about the respective methods and their specifics, but rather emphasize how to use Mplus software properly. Tips and tricks how to handle programming situations in Mplus will be provided.

## Day-to-day Schedule and Literature:

Day	Topic(s)
1	<ul style="list-style-type: none"> <li>▪ Knowing the syntactical structure of Mplus code</li> <li>▪ Preparing your data and creating Mplus readable data files</li> <li>▪ Basic analytical commands</li> <li>▪ Reading and interpreting your output</li> </ul>
	<p><u>Suggested reading:</u></p> <ul style="list-style-type: none"> <li>▪ Geiser (2011/2012): Chapter 1, 2</li> <li>▪ Christ &amp; Schlüter, 2011: 1-30</li> </ul>
2	<ul style="list-style-type: none"> <li>▪ Latent variable models</li> <li>▪ Multi-group comparisons</li> <li>▪ Advanced latent variable modeling with model constraints</li> <li>▪ Mplus-Diagrammer</li> </ul>
	<p><u>Suggested reading:</u></p> <ul style="list-style-type: none"> <li>▪ Geiser (2011/2012): Chapter 3.4 (CFA = Confirmatory Factor Analysis), Chapter 4.1.4 (Measurement Invariance), Chapter 4.2 (LST models = Latent-State-Trait Models)</li> </ul>

## Preparatory Reading:

- Introduction to basic and advanced statistics: Tabachnick, B.G., & Fidell, L.S. (2012). *Using Multivariate Statistics* (6th ed.). Boston, MA: Pearson.
- Introduction to SEM: Kline, R. B. (2015). *Principles and practice of structural equation modeling* (4th ed.). New York: Guilford.
- Introductions to the Mplus software: Geiser, C. (2012). *Data Analysis with Mplus* (Series: Methodology in the Social Sciences). New York, NY: Guilford.

*For participants who understand German:*

- Geiser, C. (2011). *Datenanalyse mit Mplus: Eine anwendungsorientierte Einführung* (2. Auflage). Wiesbaden, Germany: VS Verlag.

## Additional Recommended Literature:

- Byrne, B.M. (2011). *Structural Equation Modeling with Mplus: Basic concepts, applications, and programming*. Hoboken, NJ: Taylor & Francis.
- Muthén, L.K., & Muthén, B.O. (1998–2012). *Mplus User's Guide* (7th ed.). Los Angeles, CA: Muthén & Muthén. Available online at .
- Geiser, C., Crayen, C., & Enders, C. (2017/in press). *Advanced Multivariate Data Analysis with Mplus*. Wiesbaden, Germany: Springer VS Verlag.
- Wang, J., & Wang, X. (2012). *Structural Equation Modeling: Applications using Mplus*. West Sussex, UK: Wiley.

*For participants who understand German:*

- Christ, O., & Schlüter, E. (2011). *Strukturgleichungsmodelle mit Mplus: Eine praktische Einführung*. München, Germany: Oldenbourg Verlag.