Introduction to `MplusAutomation`

Adam Garber

October 22, 2021

About me:

- I am a doctoral student in the department of Education studying quantitative methods at the University of California, Santa Barbara
- I study the development and communication of mixture modeling methods in-line with my advisor Dr. Karen Nylund-Gibson's research.
- The materials used in this course have been adapted from content I developed as a teaching assistant for courses in `Factor Analysis`, `Structural Equation Modeling`, & `Applied Mixture Modeling` taught by Professor Nylund-Gibson.

WHAT is `MplusAutomation` & WHY schould we use it?

WHAT?

- `MplusAutomation` is an `R` package
- It "wraps around" the `Mplus` program
- Requires both `R` & `Mplus` software
- Requires learning some basics of 2 programming languages
- Car metaphor: R/Rstudio is the *steering wheel or dashboard* & Mplus is the *engine*

WHY?

- As a data analyst using Mplus to analyze projects that often span multiple years I realized a need for clearly organized work procedures in which every research decision can be documented in a single place.
- The motivation for using this method is to increase reproducibility, organization, efficiency, and transparency

HOW?

- We will interface entirely within R-Studio.
- The code presented will be very repetitive by design. Creating a consistent routine is key!

Citing `R`, `Mplus`, & `MplusAutomation`

- It is important to recognize & acknowledge the large contribution provided by these great resources.
- This course is made possible by the availability of the following software:

R Core Team (2017). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. URL http://www.R-project.org/

Muthén, L.K. & Muthén, B.O. (1998-2017). Mplus User's Guide. Eighth Edition. Los Angeles, CA: Muthén & Muthén

Hallquist, M. N., & Wiley, J. F. (2018). MplusAutomation: An R Package for Facilitating Large-Scale Latent Variable Analyses in Mplus. Structural equation modeling: a multidisciplinary journal, 25(4), 621-638.

Goals (estabishing a `routine`):

- The goal of this method is to have a self-contained project in a single location containing all relevant code for analysis and presentation of results.
- In the design of this course I considered the following 3 principles:

1. Accessibility
2. Communication
3. Organization

Participation

- To get the most out of the course **I highly recommend** following along during the recordings and writing/running the code yourself. Feel free to pause the recording to catch up or review any of the steps.
- There is no substitute for practice. Learning `MplusAutomation` requires trial and error to memorize the routine (i.e., lots of repetition).

All R scripts & materials can be downloaded at the Github repository found here:

https://github.com/garberadamc/Quant-Fish-START

To download the complete repository containing all Mplus input & output files see the following repository:

https://github.com/garberadamc/Quant-Fish-END

Scope of Course

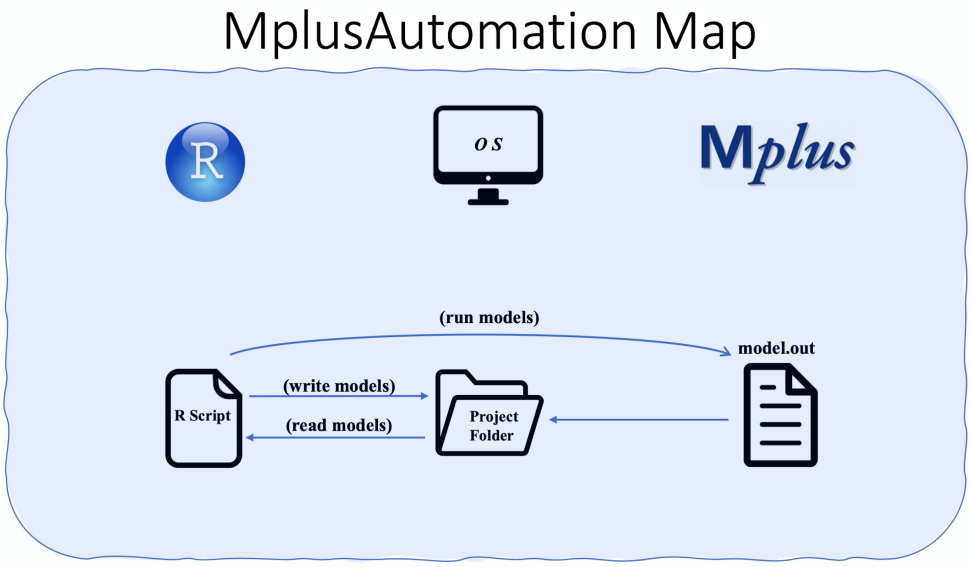
- It is assumed that participants taking this course have previous experience with `R` & `Mplus`.
- The course will focus on procedures to implement a range of Structural Equation Modeling (SEM) analyses using `MplusAutomation`.
- The conceptual or technical details of these models are beyond the scope of this course.
- I will rely on tools such as `Rmarkdown` & `Github` for teaching purposes but no experience with these tools is necessary to follow or implement the analyses.

Preparing to work with MplusAutomation - Tools for Reproducibility

A Tidy Approach to MplusAutomation

Tools for Reproducibility - A Tidy Approach to MplusAutomation

Tool/Package	Purpose/Utility	Advantages
Mplus software	Comprehensive SEM modeling support	High modeling flexibility
{MplusAutomation}	Conduit between R & Mplus	Organization & documentation
R Project	Project containment	Ease of sharing or portability
{here} package	Unbreakable/consistent file paths across OS	Reproducibility (for Science's sake!)
{tidyverse} package	Intuitive/descriptive function names	Accessibility to new users & translation
{haven} package	View-able metadata in R from SPSS data-files	Getting to know your measures
{ggplot2} package	Clear, customizable, reproducible figures	Publication quality data visualizations
pipe operator (%>%)	Readable sequences of functions	first() %>% and_then() %>% and_finally()
Rmarkdown	Integrating R code, text, output, and Latex	Communication & presentation
Github	Version control & sharing repositories	Collaboration & accessability
Project sub-folders	Sorting large quantities of files	Order, tidiness, & efficiency



A note about choosing the location of your project folder

- A good location is on the **desktop** or within a **single folder**.
- Due to the fact that Mplus only reads the first 90 columns in each line an error will occur if the file-path is longer than this limit when using MplusAutomation to run models.

`e.g., if/your/filepath/has/many/nested/folders/it/will/be/longer/than/the/90character//limit/data.dat`

A note on coding style:

- Naming conventions: **Be consistent!**
- I use the naming convention called *lower snake case* (e.g., `this_is_lower_snake_case`)
- Annotate code generously
- Let your code breath: use **return** often to spread code chunks out vertically

---

Resources:

`Rproject` | `Rmarkdown` | `Git-Github`

- R-studio and R-Projects Tutorials
- Rmarkdown Basics Tutorial

- Connect Git-Hithub with R-studio and Download Repositories

`MplusAutomation`

- Published Documentation - Hallquist and Wiley, 2018
- Vignette Examples - Hallquist

References

Hallquist, M. N., & Wiley, J. F. (2018). MplusAutomation: An R Package for Facilitating Large-Scale Latent Variable Analyses in Mplus. Structural equation modeling: a multidisciplinary journal, 25(4), 621-638.

Muthén, L.K. and Muthén, B.O. (1998-2017). Mplus User's Guide. Eighth Edition. Los Angeles, CA: Muthén & Muthén

R Core Team (2017). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. URL http://www.R-project.org/

Wickham et al., (2019). Welcome to the tidyverse. Journal of Open Source Software, 4(43), 1686, https://doi.org/10.21105/joss.01686

Further resources & examples here:

https://garberadamc.github.io/project-site/

https://www.adam-garber.com/
