

**APSTA-GE 2042 Advanced Topics in Quantitative Methods:
Multi-Level Modeling – Nested and Longitudinal Data (2 credits)**

Marc Scott

Fall 2023

Lecture: Tuesday 4:55-7:25pm (1st 7 weeks of term)

Location: Silver, Room 408

Course Assistant: Xinming Dai <xd2145@nyu.edu>

Instructor Office Hours: Tuesday 3:45-4:40pm (207W Kimball)

Course Assistant Office Hr.: Thursday 6:00-7:00pm (via Zoom)

Optional Texts: Bryk and Raudenbush, *Hierarchical Linear Models: Applications and Data Analysis Methods*; Rabe-Hesketh and Anders Skrondal, *Multilevel and Longitudinal Modeling Using Stata (Volume 1)*.

Software: R

Note: This course will use NYU Brightspace. **Email is the preferred form of communication.**

COURSE OVERVIEW: This is a course on models for multilevel nested data. These data arise in nested designs, which are quite common to education and applied social, behavioral and policy science. Traditional methods, such as OLS regression, are not appropriate in this setting, as they fail to model the complex correlational structure that is induced by these designs. Proper inference requires that we include aspects of the design in the model itself. Moreover, these more sophisticated techniques allow the researcher to learn new and important characteristics of the social and behavioral processes under study. In this module, we will develop and fit a set of models for nested designs (these are sometimes called hierarchical linear models). The course assignments will use state of the art statistical software to explore, fit and interpret the models.

COURSE PREREQUISITE: APSTA-GE 2003; APSTA-GE 2004 or 2122 recommended

COURSE REQUIREMENTS:

Participation:	10%	You are expected to attend class and participate in class discussions. The bulk of the participation points are determined by discussion of Topic Questions posted on Ed Discussion accessed via Brightspace. Spend at least 20 minutes per week on the Discussion Board (reading; commenting for credit; not merely liking).
Labs (Shiny App):		There are 4 labs that are self-contained explanations of core material. You are expected to spend at least 40 minutes on each, reviewing these outside of class time. They are intended to make concrete many of the abstract ideas. We will sometimes use office hours or even class time to review them. See Brightspace for the timing of these.
Activities (Shiny App):		You are expected to spend 30 minutes reviewing the weekly activities and the self-assessment before class (there are 6 of these).
Self-Assess./Homework:	50%	There will be weekly sets of activities that will require some computing, analysis, and interpretation. There are three aspects to self-assessment/homework: i) Use of the Shiny App to guide all aspects; ii) R coding to solve the homework questions (hand in on Brightspace). iii) online entry of responses to self-assessment and homework via a Google form.
Project:	40%	There will be a data analysis project (and write-up) instead of a final exam.

Course instruction time (**Note:** this does not include homework/project/form entry time):

	Type of activity	Number of times	Minutes per activity	Total Time Spent on Activity
Lecture	Classroom	7	150	1050
Self-Assessment	Guided Learning Tool	6	30	180
Lab	Guided Learning Tool	4	40	160
Ed Discussion	Monitored Forum	6	20	120
TOTAL				1510

COURSE HANDOUTS: PDFs of chapters will be available on NYU Brightspace. Many students prefer the bookdown format, for which we give a link. However, Bookdown cannot be downloaded, which is

why we provide PDF chapters. It is the student's responsibility to download and review the notes before coming to class.

COURSE READINGS: There is no assigned text for this course, but students are encouraged to purchase AT LEAST ONE of the two optional texts mentioned above. Bryk & Raudenbush (BR) is considered one of the 'classic' texts in MLMs. CHAPTER HANDOUTS for every class are a lot like a book – you should make every effort to read these before class and then again afterwards, to be sure that you fully understand the material. We only cover a portion of each handout in class, so ask questions in class, in office hours, or through email.

Suggested readings are posted in the schedule – they are useful readings, *but only roughly match* the weekly topics. Rabe-Hesketh & Skrondal (RS) is a newer book that is linked to the STATA package, and thus could prove a very useful reference. It has good discussion of the topics as well, but in more technical terms. Chapter 1 of RS is a good review of regression, and we will cover parts of chapters 2-4, 10 & 11. Readings from two chapters of the Sage Handbook of MLM will be made available through Brightspace.

DUE DATES: All Homeworks are DUE on Monday 8am following the class in which they are discussed. A grace period allows you to hand in the assignment by 5pm Monday without penalty. You should work on the homework well in advance of this deadline in case you have questions for the instructor or course assistant.

COLLABORATION POLICY: In this course you are welcome to discuss the assignments or shiny apps with your classmates. However, all students must submit their own work (e.g. not a group assignment, **nor a copy** of your classmate's work). However, please keep in mind that if you do not complete assignments by yourself, you will not do well on the final project, and everyone will have a slightly different final project. Struggling through a problem is an integral part of learning how to solve similar problems. One guiding principle is that you may choose to discuss a problem more broadly and collaborate on which concepts from the course may be appropriate for it but not comparing final answers or step-by-step processes with your classmates.

AI tools: You may use AI tools to scaffold your writing, the way that Grammarly does. **Cutting and pasting generative AI for coding or textual responses is not allowed**, because it is not your own work or thinking.

LATE ASSIGNMENT POLICY: Assignments are to be handed in on time (10% grade penalties will be imposed every day of lateness; after solutions are distributed no more homeworks will be accepted).

SCHEDULE ON NEXT PAGE

SCHEDULE for Fall 2023

<i>Date</i>		<i>Topic</i>	<i>Book chapters</i>	<i>Readings</i>
Sept.	5	The logic of hierarchical models; Model specification; variance components; Maximum Likelihood Estimation	BR 1,2; RH 2	Handout Chap 1; Chap 1 MLM Handbook (skip tech. parts)
	12	What are random effects? Different notations/conceptualizations;	RH 2,3	Handout Chap 2; Chap. 2 MLM Handbook
	19	Model selection using likelihood ratio tests; Random slopes/implicit interactions	BR 3,4; RH 4	Handout Chap 3; Peugh
	26	Random slopes (redux), BLUPs, types of residuals		Handout Chap 4
Oct.	3	Non-linearity; non-nested models; targeted variance, pseudo-R ² ; Nested longitudinal data	BR 4,5; RH 2,4 and RH 10,11 (2 nd Ed) or RH 8,9 (3 rd Ed.)	Handout Chap 5; Cheng, et al.
	10	NO CLASS (Monday classes meet)		
	17	Centering; hybrid models; The choice between fixed and random effects	BR p. 121, RH p. 151	Handout Chap. 6, MLM Handbook Chap 5
	24	Selected topics (Last day of class)		TBD
	31	FINAL PROJECT due (TUESDAY, 8am)		