<u>**EPID 787**</u>
An Introduction of Multilevel Analysis in Public Health
July 18-22, 2016 M-F -1:30-5:00 p.m.

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                                        appointment

Course Description: Multilevel analysis is an essential analytic tool in epidemiology and public health
that allows the simultaneous investigation of the effects of factors defined at
multiple levels on individual-level outcomes. This short course will review the
rationale for multilevel analysis in public health research, build the theory and
practice of these models from the fundamentals of the statistical approach and
demonstrate a variety of different forms that the models can take. Fitting and
interpreting models will demonstrate using SAS statistical software; all code is
available in Stata 13 statistical software as well. Special emphasis will be placed
on the strengths and limitations of mulitlevel analysis in investigating social and
group-level determinants of health.

Course Materials: Lecture slides, sample data sets, daily exercises, and articles for discussion will
be available on the CTools website

Recommended reading:

1. Diez Roux AV. Multilevel analysis in public health research. Annu Rev Public Health 2000;
   21:171-92.
2. Merlo J, Chaix B, Yang M, Lynch J, Rastam L. A brief conceptual tutorial on multilevel analysis in
   social epidemiology: interpreting neighbourhood differences and the effect of neighbourhood
   characteristics on individual health. J Epidemiol Community Health 2005;59(12):1022-8.
3. Bingenheimer JB and Raudenbush SW. Statistical and substantive inferences in public health:
   Issues in the Appliation of multilevel models. Annu Rev Public Health 2004; 25: 53-77.
4. Black JL, Macinko J, Beth Dixon L, Fryer GE. Neighborhoods and obesity in New York City.
   Health & Place 2010; 16: 489-499. *(Example using the Community Health Survey, which is the
   source for our practice dataset)*
5. Kelly AB, O'Flaherty M, Connor JP, et al. The influence of parents, siblings and peers on pre- and
   early-teen smoking: A multilevel model. Drug and Alcohol Review 2011; 30: 381-387. *(Example)*

Pre-requisites: Knowledge of basic epidemiology and linear and logistic regression.

Course Goals: By the end of the course, participants will be able to

- Explain the biostatistical and epidemiologic theories behind using multiple levels of organization to answer population health research questions
- Critically review studies that have employed multi-level analytic techniques
- Compare and contrast random-effects models with GEE models
- Select an analytical strategy appropriate to their research question
- Conduct multi-level analysis and interpret statistical output using SAS

Competencies: Students will be exposed to material that touches on the following competencies:

1. Calculate and interpret measures of event frequency (e.g. prevalence, incidence) and measures of association (e.g. odds ratio, relative risk, attributable risk) and be able to articulate the uses and limitations of these measures.
2. Know the different epidemiologic study designs including the relative strengths and weaknesses of each, and be able to propose an appropriate design strategy when presented with a research question.
3. Understand and be able to apply analytical approaches to data from different epidemiologic study designs (e.g. cross-sectional, cohort, randomized studies).
4. Be exposed to published epidemiologic studies and be able to critically appraise epidemiological findings.

Course Requirements: Students will be expected to complete and turn in a daily exercise.

For Example:

Exercise #1	25%
Exercise #2	25%
Exercise #3	25%
Exercise #4	25%
	100%

Classroom Expectations/Etiquette:

Students are expected to come prepared with laptops that have SAS (or Stata) software already installed. The format of the class will be a combination of lecture and in class assignment, discussion of the daily article, and in time class for the daily assignment. There are four discussion articles to review. On the first day, students can volunteer to be the discussion leader for the daily article rather than complete one of the four assignments. The student will then be graded on the preparation and presentation of the daily article (5 min overview), and quality of the discussion questions (15-20 minute discussion). If more than four students volunteer, the four selected students will be randomly chosen.

Academic Integrity:

The faculty and staff of the School of Public Health believe that the conduct of a student registered or taking courses in the School should be consistent with that of a professional person. Courtesy, honesty, and respect should be shown by students toward faculty members,

guest lecturers, administrative support staff, community partners, and fellow students. Similarly, students should expect faculty to treat them fairly, showing respect for their ideas and opinions and striving to help them achieve maximum benefits from their experience in the School.

Student academic misconduct refers to behavior that may include plagiarism, cheating, fabrication, falsification of records or official documents, intentional misuse of equipment or materials (including library materials), and aiding and abetting the perpetration of such acts. Please visit http://www.sph.umich.edu/academics/policies/conduct.html for the full SPH Code of Academic Integrity and further definition of these terms.

Student Well-being:

SPH faculty and staff believe it is important to support the physical and emotional well-being of our students. If you have a physical or mental health issue that is affecting your performance or participation in any course, and/or if you need help connecting with University services, please contact the instructor or the Office of Academic Affairs.

Please visit http://www.sph.umich.edu/students/current/#wellness for more information.

Student Accommodations:

Students should speak with their instructors before or during the first week of classes regarding any special needs. Students can also visit the Office of Academic Affairs for assistance in coordinating communications around accommodations.

Students seeking academic accommodations should register with Services for Students with Disabilities (SSD). SSD arranges reasonable and appropriate academic accommodations for students with disabilities. Please visit http://ssd.umich.edu/accommodations for more information on student accommodations.

Students who expect to miss classes, examinations, or other assignments as a consequence of their religious observance shall be provided with a reasonable alternative opportunity to complete such academic responsibilities. It is the obligation of students to provide faculty with reasonable notice of the dates of religious holidays on which they will be absent. Please visit http://www.provost.umich.edu/calendar/religious_holidays.html#conflicts for the complete University policy.

Course Topics/Reading List:

Session 1 – Introduction to Multi-Level Models: Concepts & Data Structures
7-18-16   Learning Objectives: Explain the basic theory behind multi-level models   Identify the general distinctions between different types of multi-level models   Introduce basic GIS concepts & methods   Discuss potential issues that arise when defining and measuring a group level variable   Begin exploration of the dataset to be used for the in class exercises

Session 2 – Introduction to General Linear Mixed Models

7-19-16   Learning Objectives:

Describe the distinction between OLS and a basic General Linear Mixed Model

Explain the equations of General Linear Mixed Models

Present the Intraclass correlation coefficient (ICC)

Introduce Proc MIXED and similar Stata procedures

Discuss random intercept models with level-1 and level-2 predictors

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Session 3 – Graphing Linear Mixed Models & Testing Model Assumptions

7-20-16   Learning Objectives:

Review random intercept models

Introduce random slope models

Explore Random intercepts and random slopes with graphs

Model Building and Testing assumptions

Session 4 – Generalized Linear Mixed Models, Cross-level Interactions & Sample Size

7-21-16   Learning Objectives:

Examine cross-level interactions

Critically evaluate a mixed model article

Explain mixed models with binary outcomes

Introduce Proc GLIMMIX and similar Stata procedures

Understand sample size & power in a multi-level study

Session 5 –Sample Size, Generalized Estimating Equations (GEE) & more complex models

7-22-16   Learning Objectives:

Explain Generalized Estimating Equations

Compare GEE to Mixed models

Discuss options in Proc GLIMMIX and similar Stata procedures

Introduce 3 level and Cross-classified models