Syllabus Module 230 Major B ISB: Multi Level Analysis

230	Introduction to Multi Level Analysis
Coordinators	Jay S KAUFMAN, PhD, Professor of Epidemiology McGill University, Canada Tarik Benmarhnia, PhD, Associate Professor, Scripps Institution of Oceanography, University of California San Diego, USA.
Dates	December 13th to 17th, 2021
Credits/ECTS	3 ECTS
Duration or Course Format	5 days of 6 hours = 30 hours
Location	EHESP 20 Avenue George Sand 93210 LA PLAINE ST DENIS
Description	Multilevel analysis has emerged as a useful analytical technique in several fields, including public health and epidemiology. Multilevel analysis allows for clustered data that represents a hierarchical structure, and allows for measurements at each level and effect estimate or predicted values at each level. The techniques also apply equally to data nested within individuals, as in a longitudinal setting and policy evaluation using quasi-experimental methods. This course also covers different approaches relying on fixed effect modelling including panel data analysis and case crossover. Finally, the last section of the course covers 2-way fixed effects and other difference-in-differences methods and extensions including synthetic control methods.
Prerequisites	Advanced core in Biostatistics
Course learning objectives	At the end of the module, the students should be able: - Apply and fit multilevel and clustered data regression models using the STATA software package - Develop methods for hierarchical data analysis - Obtain predicted values and interpret estimated coefficients as epidemiologic parameters - Specify marginal models or cluster-specific models as appropriate - Test different models with random effects, especially linear and logistic models for additive and multiplicative effect parameters - Use fixed effect models to analyze panel data and case crossover methods - Apply quasi-experimental methods based on the timing of natural experiences including difference-in-differences methods and extensions.
Competences	**Competences:** 1) Knows how to motivate the need for multilevel modelling for a specific epidemiological question 2) Knows how to estimate and interpret coefficients from traditional and multilevel linear and logistic regression models 3) Knows the differences between fixed and random effect models as well as how to compare these 2 types of models 4) Understands the rationale and identification assumptions behind quasi-experiment methods such as 2-way fixed effects and other difference-in-differences (DiD) approaches 5) Knows how to implement difference-in-differences and extensions and test for parallel trends **Evaluation:** On Friday afternoon, the students will have a final exam of 3 hours with questions related to the motivation of multilevel modelling, the implementation and interpretation of multilevel models including the comparison of fixed and random effect models, and the implementation of DiD methods. A data set will also be provided and students will have to submit their answers (responses, syntax, hand calculations, outputs, interpretations).

Structure (details of sessions title/speaker/date /duration)	As described, below, all morning four hour sessions consist of lectures provided by Dr Jay Kaufman (from Monday to Wednesday) and Dr. Tarik Benmarhnia (Thursday and Friday), and the 3.5 Hour afternoon sessions are for lab exercises, with Dr Kaufman and Dr. Tarik Benmarhnia. Outlines per lecture are given below **Session 1**. J Kaufman's Lecture includes what follows: - Review of Regression Modeling in Epidemiology - Mean Square Error and Bias/Variance Trade-Off - James-Stein and Empirical Bayes Shrinkage - Non-Collapsibility of the Odds Ratio - Marginal versus Conditional Estimators - Simpson's Paradox and Selection Bias - Hierarchical Data Models - Random Effects ANOVA **Session 2**. Practice 3H30, Dr Kaufman **Session 3**. J Kaufman's Lecture includes what follows - Fixed Versus Random Effects - Empirical Bayes Prediction - Parameter Estimation and Model Fitting - Intraclass Correlation Coefficient - Discussion of Merlo et al 2006 - Random Intercept Models with Covariates - Between and within effects of Level-1 covariates **Session 4**. Practice 3H30, Dr Kaufman **Session 5**. J Kaufman's Lecture, includes what follows - Cluster-level confounding - Hausman Test for Endogeneity - Random Coefficient Models - Review of Effect Heterogeneity - Discussion of Merlo et al 2006 - Marginal Models - Models for Categorical Responses - Random Intercept Logistic Regression - Median Odds Ratio - Predicted Probabilities from Categorical Models - Random Effects Poisson Regression Models **Session 6**. Practice 3h30, Dr Benmarhnia Session 7 T Benmarhnia Lecture includes what follows: - Causal Inference in Observational Studies - Fixed Effect for Panel Data and Case Crossover designs - Difference-in-differences methods **Session 8**. Practice 3h30, Dr Benmarhnia **Session 9** T Benmarhnia Lecture, includes what follows: - Applied examples - Questions/Answers/Summary of the week **Session 10**. Final Exam 3h30, Drs. Kaufman & Benmarhnia
Resources	Greenland S. Principles of multilevel modelling. Int J Epid 2000: 29(1):158-67. Efron & Morris. Stein's Paradox in Statistics. Scientific American 1977; 236: 119-127. Kaufman et al Modeling Community-level Effects on Preterm Birth (2003) AEP Vol. 13 (5). 5377–384 doi:10.1016/S1047-2797(02)00480-5 Merlo J, Chaix B, et al (2005a) A brief conceptual tutorial of multilevel analysis in socialepidemiology: linking the statistical concept of clustering to the idea of contextual phenomenon J Epidemiol Community Health, 59:443–449. doi: 10.1136/jech.2004.023473 Merlo J, Chaix, B et al THEORY AND METHODS (2005b) A brief conceptual tutorial on multilevel analysis in social epidemiology: investigating contextual phenomena in different groups of people, J Epidemiol Community Health 59:729–736. doi: 10.1136/jech.2004.023929 Schempf AH, Kaufman JS et al (2011) The Neighborhood Contribution to Black- White Perinatal

	Disparities: An Example From Two North Carolina Counties, 1999– 2001American Journal of Epidemiology Vol. 174, No. 6 DOI: 10.1093/aje/kwr128 Schempf AH, Kaufman JS (2012) Accounting for context in studies of health inequalities: a review and comparison of analytic approaches, Annals of Epidemiology, Volume 22, Issue 10: 683–690 RabeHesketh & Skrondal "Multilevel and Longitudinal Modeling Using Stata" (2012), 3rd Edition, chapter 2. Hawkins SS, Chandra A, Berkma L (2012) The Impact of Tobacco Control Policies on Disparities in Children's Secondhand Smoke Exposure: A Comparison of Methods, Mater Child Health 16: S70-S77 Harper S, Strumff EC, Kaufman JS (2012) Do Medical Marijuana Laws Increase Marijuana Use? Replication Study and Extension, AEP 22(3) 207-212 Craig, P., Katikireddi, S. V., Leyland, A., & Popham, F. (2017). Natural experiments: an overview of methods, approaches, and contributions to Public Health intervention research. Annual review of public health, 38, 39-56. Dimick, J. B., & Ryan, A. M. (2014). Methods for evaluating changes in health care policy: the difference-in-differences approach. Jama, 312(22), 2401-2402. Wing, C., Simon, K., & Bello-Gomez, R. A. (2018). Designing difference in difference studies: best practices for public health policy research. Annual review of public health, 39. Bouttell, J., Craig, P., Lewsey, J., Robinson, M., & Popham, F. (2018). Synthetic control methodology as a tool for evaluating population-level health interventions. J Epidemiol Community Health, 72(8), 673-678.
Course requirement	Students will practice exercises in **Stata software** during each afternoon lab session and will do additional homework practice.
Grading and assessment	Written in class exam is scheduled on 2021 Dec 17, 2:00 -5:00 pm Note also that students will complete a questionnaire that assesses their own and their teammates' contributions to group work. All team members will receive the same grade except if it is clear that a student has not participated effectively (attended and contributed to meetings; made timely, helpful contributions; been constructive, etc.). In that case, the student's grade will be lowered accordingly.
Course policy	**Attendance & punctuality** **Regular and punctual class attendance is a prerequisite for receiving credit in a course.** Students are expected to attend each class. Attendance will be taken at each class. The obligations of attendance and punctuality cover every aspect of the course: - lectures, conferences, group projects, assessments, examinations, as described in EHESP Academic Regulations http://mph.ehesp.fr EHESP Academic Regulation Article. 3). If students are not able to make it to class, they are required to send an email to the instructor and to the MPH program coordinating team explaining their absence prior to the scheduled class date. All supporting documents are provided to the end-of-year panel. . Students who miss class are responsible for content. Any student who misses a class has the responsibility for obtaining copies of notes, handouts and assignments. If additional assistance is still necessary, an appointment should be scheduled with the instructor. Class time is not to be used to go over material with students who have missed class. **Lateness**: Students who are more than 10 minutes late may be denied access to a class. Repeated late arrivals may be counted as absences (See http://mph.ehesp.fr EHESP Academic Regulation Article. 3 Attendance & Punctuality) **Maximum absences authorized & penalty otherwise** Above 20% of absences will be designated a fail for a given class. The students will be entitled to be reassessed in any failed component(s). If they undertake a reassessment or they retake a module this means that they cannot normally obtain more than the minimum pass mark (i.e. 10 out of 20) **Exceptional circumstances**

	Absence from any examination or test, or late submission of assignments due to illness, psychological problems, or exceptional personal reasons must be justified; otherwise, students will be penalized, as above mentioned. Students must directly notify their professor or the MPH academic secretariat before the exam or before the assignment deadline. Before accepting the student's justification, the professor or the MPH academic secretariat has the right to request either a certificate from the attending physician or from a psychologist, or from any other relevant person (See http://mph.ehesp.fr EHESP Academic Regulation Article 4 Examinations). **Courtesy**: All cell phones/pages MUST be turned off during class time. Students are required to conduct themselves according to professional standards, eating during class time is not permitted during class time, such as course or group work.
Valuing diversity	Diversity enriches learning. It requires an atmosphere of inclusion and tolerance, which oftentimes challenges our own closely-held ideas, as well as our personal comfort zones. The results, however, create a sense of community and promote excellence in the learning environment. This class will follow principles of inclusion, respect, tolerance, and acceptance that support the values of diversity. Diversity includes consideration of: (1) life experiences, including type, variety, uniqueness, duration, personal values, political viewpoints, and intensity; and (2) factors related to "diversity of presence," including, among others, age, economic circumstances, ethnic identification, family educational attainment, disability, gender, geographic origin, maturity, race, religion, sexual orientation and social position.
Course evaluation	EHESP requests that you complete a course evaluation at the end of the school year. Your responses will be anonymous, with feedback provided in the aggregate. Open-ended comments will be shared with instructors, but not identified with individual students. Your participation in course evaluation is an expectation, since providing constructive feedback is a professional obligation. Feedback is critical, moreover, to improving the quality of our courses, as well as for instructor assessment.