

**Hierarchical Models**  
Winter School in Methods and Data Analysis UCU-DCSP

Instructor:  
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### **Course Objectives**

The aim of this course is to familiarise students with the multilevel framework. Students will learn how to estimate basic multilevel models using R, and to interpret the results. By the end of the course, students will be familiar with the most common applications of multilevel models in the social sciences.

### **Description**

The course covers statistical models that account for observed hierarchies. Such hierarchical structures provide great opportunities for research. The course introduces the statistical tools for dealing with these hierarchies. The course begins with multilevel linear models, then moves on to multilevel models with dichotomous outcomes, and finally covers multilevel generalized linear models. In each case, the course focuses on how to specify, fit, and check multilevel models in R.

### **Required Background**

The course assumes a basic knowledge of hypothesis testing, the linear regression model, and probability theory. A basic familiarity with R is helpful.

### **Readings**

#### *Required text*

Gelman, Andrew & Jennifer Hill (2007). *Data Analysis Using Regression and Multilevel/Hierarchical Models*. Cambridge: Cambridge University Press.

#### *Background reading*

Gelman, Andrew, Boris Shor, Joseph Bafumi & David Park (2007). Rich State, Poor State, Red State, Blue State: What's the Matter with Connecticut? *Quarterly Journal of Political Science*. 345--367. Available online at [http://www.stat.columbia.edu/~gelman/research/published/rb\\_qjps.pdf](http://www.stat.columbia.edu/~gelman/research/published/rb_qjps.pdf)

Keele, Luke (2006) *An Introduction to R*. Available at: <http://www.personal.psu.edu/ljk20/RIntro.pdf>

## Course outline

Day 1: Introduction and Motivation.

Readings: Gelman & Hill, Chapters 1 and 2.

Lab: Introduction to R.

Day 2: Review of Linear and Generalized Linear Models.

Readings: Gelman & Hill, Chapters 3 and 4.

Lab: Estimating Linear and Generalized Linear Models in R.

Day 3: Multilevel Structures and Multilevel Linear Models: The Basics.

Readings: Gelman & Hill, Chapters 11 and 12.

Lab: Introduction to the lmer package. Estimating basic multilevel models and interpreting the results.

Day 4: Multilevel Linear Models: Varying Slopes, Non-Nested Models and Other Complexities.

Readings: Gelman & Hill, Chapter 13.

Lab: Specifying more complex multilevel structures in R.

Day 5: Multilevel Logistic Regression, Multilevel Generalized Linear Models.

Readings: Gelman & Hill, Chapters 14 and 15.

Lab: Estimating and interpreting multilevel generalized linear models in R.