

# WSSR WORKSHOPS ON SOCIAL SCIENCE RESEARCH

## Hierarchical Linear Models

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May 23-24, 2018

9:00am – 4:30pm

### Summary

This workshop introduces hierarchical/multilevel regression-style linear models (and a few basic nonlinear forms) in a manner accessible to social and behavioral scientists. These models account for levels of aggregation that are typical in social science data in which individuals are nested in groups, and possibly multiple groups. Since these specifications are inherently Bayesian in nature this workshop will also introduce the basic principles of Bayesian statistics to students in the social and behavioral sciences without requiring an extensive background in mathematical statistics. Most of the examples will be drawn from sociology, political science, economics, marketing, psychology, public policy, and anthropology.

The prerequisites for this workshop are a linear regression course and knowledge of matrix algebra. The emphasis will be on applying the principles to actual data-analytic problems of interest to participants rather than through textbook examples. The workshop will make extensive use of software that is in the public domain, yet is high in quality

### Note to all participants:

Please make sure to bring your own laptop to the workshop and download the following two programs in advance:

- R: <https://www.r-project.org/>
- JAGS: <http://mcmc-jags.sourceforge.net/>

### Outline

#### Multilevel Models

1. Advantages of Multilevel Models
2. Features of Multilevel Models
3. Modern Notation
4. Linear Model Illustration
5. Vocabulary Overview
6. Comparison with Variable Contrasts
7. Partial Pooling Estimates with No Explanatory Variables
8. Contrasting Pooling Approaches
9. Presenting Results from Multilevel Models
  - a. Simple Illustration of Bayesian Inference
  - b. Specifications with the lmer() Function
10. A Bayesian Take on Hierarchical Models
11. Panel Data as Group Membership
12. Varying Intercept Logit Multilevel Model
13. Bayesian Multinomial Specifications for Employment Status
14. Random Effects Example for Indomethacin Trials



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15. Nested Classification Factors
16. Simple Linear Bayesian Specification: Poverty Among the Elderly, Europe
17. Prior Sensitivity, ANES Data from 2012
18. Logit Model for Survey Responses in Scotland, Percent Predicted Correctly
19. Another application: Poisson Model of Military Coups

## **Required Readings\***

- King, Gary (1986) "How Not to Lie With Statistics: Avoiding Common Mistakes in Quantitative Political Science". *American Journal of Political Science*, 30, 666-687, 1986.  
<http://reserves.concordia.ca/ares/ares.dll/plink?u-http%3A%2F%2F0-dx.doi.org.mercury.concordia.ca%2F10.2307%2F2111095>
- Gill, Jeff and Andrew J. Womack (2013) "The Multilevel Model Framework". In *The SAGE Handbook of Multilevel Modeling*. Scott, Marc A, Jeffrey S Simonoff and Brian D Marx (eds). London: SAGE Publications Ltd, pp. 3-20. SAGE Research Methods. <http://pages.wustl.edu/files/pages/imce/jgill/mlmchap4.pdf>
- Gill, Jeff and Chris Witko (2013) "Bayesian Analytical Methods: A Methodological Prescription for Public Administration". *Journal of Public Administration Research and Theory*, 23:2, pp. 457-494.  
<http://reserves.concordia.ca/ares/ares.dll/plink?u-http%3A%2F%2F0-dx.doi.org.mercury.concordia.ca%2F10.1093%2Fjopart%2Fmus091>
- Snijders Tom A.B. (2011) "Multilevel Analysis". In *International Encyclopedia of Statistical Science*. Lovric M. (eds). Berlin: Springer. [https://link.springer.com/referenceworkentry/10.1007%2F978-3-642-04898-2\\_387](https://link.springer.com/referenceworkentry/10.1007%2F978-3-642-04898-2_387)
- Gelman, Andrew (2006) "Multilevel (Hierarchical) Modeling: What It Can and Cannot Do". *Technometrics*, 48:3, pp. 432-435. <http://reserves.concordia.ca/ares/ares.dll/plink?u-http%3A%2F%2F0-dx.doi.org.mercury.concordia.ca%2F10.1198%2F004017005000000661>

## **Additional Resources**

Government 2003: Bayesian Hierarchical Models (Harvard University), some code and references at  
<http://jeffgill.org/Teaching/gov.2003.html>

\*If you are registered for non-credit and are unable to access these readings, please send us an email at [wssr@concordia.ca](mailto:wssr@concordia.ca) and we will do our best to assist you.

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