WSSR — WORKSHOPS ON SOCIAL SCIENCE RESEARCH

Non-Linear Hierarchical Modelling

Dr. Jeff Gill
Professor, American University
May 25, 2018
9:00am – 4:30pm

Summary

This workshop covers statistical nonlinear model development with explicitly defined hierarchies. Such multilevel specifications allow researchers to account for different structures in the data and provide for the modeling of variation between defined groups.

The workshop begins with simple nested linear models and proceeds on to non-nested models, multilevel models with dichotomous outcomes, and multilevel generalized linear models. In each case, a Bayesian perspective on inference and computation is featured.

The focus in the workshop will be practical steps for specifying, fitting, and checking multilevel models with much time spent on the details of computation in the R and BUGS environments.

At the conclusion of this workshop participants will: be able to specify and estimate multilevel (hierarchical) models with nonlinear outcomes, and will have had exposure to Bayesian approaches including MCMC computation, as well as be able to assess model reliability and fit in multilevel models.

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
1. Motivating Example
   a. The Bureaucratic Politics Example
   b. Ordered Logit Models
2. Bayesian Stochastic Simulation
   a. What is a Stochastic Process?
   b. What is a Markov Chain?
   c. A Two State Markov Chain
   d. The Chapman-Kolmogorov Equations
   e. Marginal Distributions
   f. Markov Chain Properties
3. The Gibbs Sampler
   a. The Gibbs Sampler, Realistic Example
   b. Bayesian Tobit Model for Death Penalty Support
4. The Metropolis-Hastings Algorithm
   a. Simple Metropolis-Hastings Example
   b. The Hit-and-Run Algorithm
5. BUGS Software for MCMC

Required Readings*

Wong, George Y. and William M. Mason (1984) "The Hierarchical Logistic Regression Model for Multilevel Analysis". *Journal of the American Statistical Association*, 80, pp. 513-524. http://reserves.concordia.ca/ares/ares.dll/plink?14EF21C4

Bauer, Daniel J. and Patrick J. Curran (2010) "Probing Interactions in Fixed and Multilevel Regression: Inferential and Graphical Techniques", *Multivariate Behavioral Research*, 40:3, pp. 373-400. http://reserves.concordia.ca/ares/ares.dll/plink?u-http%3A%2F%2F0-dx.doi.org.mercury.concordia.ca%2F10.1207%2Fs15327906mbr4003_5

DiPrete, Thomas and Jerry D. Forristal (1994) "Multilevel Models: Methods and Substance". *Annual Review of Sociology*, 20:1, pp. 331-357. http://reserves.concordia.ca/ares/ares.dll/plink?u-http%3A%2F%2F0-search.ebscohost.com.mercury.concordia.ca%2Flogin.aspx%3Fdirect%3Dtrue%26db%3Dbth%26AN%3D9409062870%26site%3Dehost-live%26scope%3Dsite

Vehtari, A., Gelman, A. & Gabry (2017) "Practical Bayesian Model Evaluation Using Leave-One-Out Cross Validation and the WAIC". *Journal of Statistical Computing*, 27, pp. 1413-1432. http://reserves.concordia.ca/ares/ares.dll/plink?u-https%3A%2F%2Flink.springer.com%2Farticle%2F10.1007%252Fs11222-016-9696-4

Tsai, T. A Bayesian (2016) "A Bayesian Approach to Dynamic Panel Models with Endogenous Rarely Changing Variables". *Political Science Research and Methods*, 4(3), pp. 595-620. http://reserves.concordia.ca/ares/ares.dll/plink?u-https%3A%2F%2F0-search-proquest-com.mercury.concordia.ca%2Fdocview%2F1951416747%2FCC93634C388E4B42PQ%2F7%3Faccountid%3D10246

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 and we will do our best to assist you.