World Academy of Science, Engineering and Technology
International Journal of Psychological and Behavioral Sciences
Vol:11, No:10, 2017

# Understanding Mathematics Achievements among U. S. Middle School Students: A Bayesian Multilevel Modeling Analysis with Informative Priors

**Authors :** Jing Yuan, Hongwei Yang

**Abstract :** This paper aims to understand U.S. middle school students' mathematics achievements by examining relevant student and school-level predictors. Through a variance component analysis, the study first identifies evidence supporting the use of multilevel modeling. Then, a multilevel analysis is performed under Bayesian statistical inference where prior information is incorporated into the modeling process. During the analysis, independent variables are entered sequentially in the order of theoretical importance to create a hierarchy of models. By evaluating each model using Bayesian fit indices, a best-fit and most parsimonious model is selected where Bayesian statistical inference is performed for the purpose of result interpretation and discussion. The primary dataset for Bayesian modeling is derived from the Program for International Student Assessment (PISA) in 2012 with a secondary PISA dataset from 2003 analyzed under the traditional ordinary least squares method to provide the information needed to specify informative priors for a subset of the model parameters. The dependent variable is a composite measure of mathematics literacy, calculated from an exploratory factor analysis of all five PISA 2012 mathematics achievement plausible values for which multiple evidences are found supporting data unidimensionality. The independent variables include demographics variables and content-specific variables: mathematics efficacy, teacher-student ratio, proportion of girls in the school, etc. Finally, the entire analysis is performed using the MCMCpack and MCMCglmm packages in R.

**Keywords :** Bayesian multilevel modeling, mathematics education, PISA, multilevel
**Conference Title :** ICP 2017 : International Conference on Psychology
**Conference Location :** Osaka, Japan
**Conference Dates :** October 09-10, 2017