Hierarchical model building, fitting, and checking: A behind-the-scenes look at a Bayesian analysis of arsenic exposure pathways

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Abstract

In this article, we present a behind-the-scenes look at a Bayesian hierarchical analysis of pathways of exposure to arsenic, a toxic heavy metal. Our analysis combines individual-level personal exposure measurements (biomarker and environmental media) with water, soil, and air observations from the ambient environment. We include details of our model-building exercise that involved a combination of exploratory data analysis and substantive knowledge in exposure science. Then we present our strategies for model fitting, which involved piecing together components of the hierarchical model in a systematic fashion to assess issues including parameter identifiability, Bayesian learning, and model fit. We also discuss practical issues of data management and algorithm debugging. We hope that our presentation of these behind-the-scenes details will be of use to other researchers who build large Bayesian hierarchical models.