

We show how to use Bayesian uncertainty analysis to study several three-way contingency tables, each obtained from a single area, when one, two or three categories are missing. This is an extension of Nandram and Woo (2015) to cover small areas. One approach to analyze these data is to construct several tables (one complete and the others incomplete) with each table corresponding to one or more missing categories. When tables are incomplete and nonignorable nonresponse models are used, there are nonidentifiable parameters. To deal with these parameters, we describe four hierarchical Bayesian models, which are an ignorable nonresponse model and three nonignorable nonresponse models. Rather than performing a sensitivity analysis, we perform the Bayesian uncertainty analysis by placing priors on nonidentifiable parameters. This is done to reduce the effects of nonidentifiable parameters that is accomplished by projecting the parameters to a lower dimensional space and allowing the reduced set of parameters to share a common distribution. Also, this procedure allows a "borrowing of strength" from larger areas to improve estimation in smaller areas. We use the gridpy Gibbs sampler to fit our models and we use goodness of fit procedures to assess model fit. We use an illustrative example and a simulation study to compare our models when inference is made about finite population proportions of the cells of the three-way tables.