

## Posterior predictive simulation Checks for hierarchical Bayesian Modelling

### ABSTRACT

**Problem statement:** Assessing the plausibility of a posited model is always fundamental in order to evaluate and examine its performance. Such assessment is essential in the field of Bayesian data analysis. A Bayesian analysis can be very misleading when the model is far from plausible. Thus, any Bayesian analysis should include an evaluation method to find out whether the posited model should be excluded because it fails to provide a reasonable summary of the data at hand. Such evaluation method is referred as the posterior predictive checks. **Approach:** In this study we review the use of the posterior predictive simulation. We propose a simulation study to evaluate and examine the adequacy of three mixed effect hierarchical Bayesian models, namely IVM, CVM and GSM. These models include different sources of variability and used to examine the trend of the relative risk associated with the disease spread in lattice grid. The evaluation is achieved by proposing different graphical and numerical posterior predictive checks to compare features of the observed data to the same features of replicate data generated under each model. The proposed method is illustrated by analyzing the well-known data set of the lip cancer in Scotland. **Results:** The graphical and the numerical results suggested that the model which includes all sources of variability (GSM) had the most similar value for both original and predicted samples, as compared to the other models. Thus, it was concluded that the GSM is the most appropriate model which could fit the data well. **Conclusion:** The method used for assessing model fitness will provide guidance for practitioners to select an adequate hierarchical Bayesian model that expect to fit the data well.

**Keyword:** Hierarchical Bayesian models; Posterior predictive simulation; Discrepancy; MCMC; Posterior distribution.