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MATHEMATICS

### **Likelihood Analysis**

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In Bayesian inference, the parameter  $\theta$  in a density  $f(x;\theta)$  is considered a random variable rather than a fixed quantity. Bayesian inference often requires the computation of difficult or impossible integrals, and in such situations, Markov Chain Monte Carlo, or MCMC, can be used to approximate these integrals.

One drawback of MCMC methods is that they require computation of a likelihood function. Unfortunately for many densities this function is difficult or impossible to compute, and hence MCMC is not possible. An alternative to traditional MCMC methods, known as likelihood free MCMC, is still being developed to deal with such situations.

We examined the current methods of likelihood MCMC and tried to determine an alternative and less computationally intensive algorithm. We developed some visual aids to test the feasibility of new algorithm, which only requires calculations involving a sufficient statistic of the data instead of the entire data set.

We compared the results of current likelihood free MCMC methods with sufficient statistic likelihood free MCMC methods graphically. Given the difficulty of using visual aids in higher dimensions, we only focused on a one dimensional parameter  $\theta$ .

The results we obtained were promising and could possibly be extended to higher dimensions. I enjoyed learning about a whole new area in statistics and seeing how the discipline continues to grow and build on current knowledge.