Bayesian Statistics, Assignment for Tuesday, Dec. 10

Our final subject is Gibbs sampling.

Reading

You are welcome to read Chapters 16 and 19 Donovan and Mickey, but I am certainly not expecting you to. I have chosen to learn Gibbs sampling and how it is applied from Chapters 1 and 2 of *Markov Chain Monte Carlo in Practice,* by Gilks, Richardson, and Spiegelhalter. I have been writing up my own version of the Gibbs sampling theory and will hand it out on Tuesday:

* https://brianhill.github.io/bayesian-statistics/resources/MonteCarloMethodsWhyDoTheyWork-III.nb.pdf

To keep all of our eyes on the final prize, I want to reiterate that we are trying to get ourselves to the point of understanding the methods used in the case study on Hepatitis B vaccination. I have also be writing up and presenting the case study, and that write-up is far along:

* https://brianhill.github.io/bayesian-statistics/resources/MonteCarloMethodsCaseStudy.nb.pdf

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In-Class Exercise Serving as Problem Set 18 — Illustrating Gibbs Sampling

Gibbs sampling only gets interesting when you are trying to sample multiple independent axes in the posterior. So our iPhone sales example, which only had one axis isn't going to cut it as a Gibbs sampling example. I am therefore going to beef up the potato-rock example to have two axes.

We are going to one axis (or attribute) of nodules be whether they are a potato or a rock. We are going to have another axis (or attribute) be whether they are small, medium, or large. The field contains some concentration of each of these six possibilities. That is our prior:

[I am still messing with these numbers trying to make a tidy example]

$N_{\text{rock small}} = 15\,000$
$N_{\text{rock medium}} = 10\,000$
$N_{\text{rock large}} = 11\,000$
$N_{\text{potato small}} = 250$
$N_{\text{potato medium}} = 1500$
$N_{\text{potato large}} = 600$

Now the potato harvester does its thing. We are going to get worn out doing manual calculations if we are not careful, so I am going to make this potato harvester work as follows:

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So what is sent to the kitchen is:

$N_{\text{rock small}} = 2500$
$N_{\text{rock medium}} = 1000$
$N_{\text{rock large}} = 500$
$N_{\text{potato small}} = 200$
$N_{\text{potato medium}} = 800$
$N_{\text{potato large}} = 0$

These have prior probabilities (the amounts in which they occur in the field), times the likelihoods (what the potato harvester does) and that is what makes the posterior probabilities (what is sent to the kitchen).

THIS EXERCISE IS FAR FROM DONE. I HAVE TO FINISH THE CONSTRUCTION OF THE POSTERIOR, AND THEN I HAVE TO SHOW HOW GIBBS SAMPLING WOULD SAMPLE THE POSTERIOR.