STAT 578 – Advanced Bayesian Modeling – Fall 2018

Assignment 3

Use the 2016 US presidential polls data in `polls2016.txt` to answer the following, running all parts using JAGS and R (`rjags`). Remember that you will have to create a variable `sigma` in R to represent the standard deviation of the polls, defined to be half of the margin of error. Refer to Lesson 4.2: Normal Hierarchical Model in R/JAGS.

(a) Use the model in `polls20161.bug` for the following:

(i) [2 pts] Create an initialization list (in R) supporting 4 chains, with a different initialization for each chain. Set initial values for `mu` to ± 100 and values for `tau` to 100 or 0.01. Then use `jags.model` to create the JAGS model R object with these initializations. List all of the R code you used.

(ii) [2 pts] Perform a burn-in of 2500 iterations, then monitor the `mu` and `tau` nodes for 5000 iterations (for each chain). List all of the R code you used.

(iii) [3 pts] For the iterations you monitored, produce trace plots of `mu` and `tau`. Do there appear to be any convergence problems? Display the plots and R code that produced them.

(iv) [2 pts] For the iterations you monitored, compute Gelman-Rubin statistics (potential scale reduction factors) for `mu` and `tau`. Do there appear to be any convergence problems? Show your R code and its output.

(v) [2 pts] For the iterations you monitored, display autocorrelation plots for `mu` and `tau` for one of the chains. (Hint: For example, to reference the first chain of an `mcmc.list` object called `x`, use `x[[1]]`.) Comment on the apparent speed of mixing.

(vi) [2 pts] For the iterations you monitored, compute effective sample sizes (over all chains) for `mu` and `tau`. Would they be considered adequate? Show your R code and its output.

(b) Now consider a new model that uses an almost flat prior for `tau` on the *log* scale: Create a new JAGS model by modifying `polls20161.bug` to eliminate the current prior for `tau`, create a new parameter `logtau` with a $U(-100, 100)$ distribution, and define `tau` to be `exp(logtau)`.

(i) [2 pts] Display all of the code for your new JAGS model.

(ii) [2 pts] Create an initialization list (in R) supporting 4 chains, with a different initialization for each chain. Set initial values for `mu` to ± 100 and values for `logtau` to $\log 100$ or $\log 0.01$. Then use `jags.model` to create the JAGS model R object with these initializations. List all of the R code you used.

(iii) [2 pts] Perform a burn-in of 2500 iterations, then monitor the `mu` and `tau` nodes for 5000 iterations (for each chain). List all of the R code you used.

(iv) [3 pts] For the iterations you monitored, produce trace plots of `mu` and `tau`. Do there appear to be any convergence problems? Display the plots and R code that produced them.

(v) [2 pts] For the iterations you monitored, compute Gelman-Rubin statistics (potential scale reduction factors) for `mu` and `tau`. Do there appear to be any convergence problems? Show your R code and its output.

(vi) [2 pts] For the iterations you monitored, display autocorrelation plots for `mu` and `tau` for one of the chains.[1] Comment on the apparent speed of mixing.

(vii) [2 pts] Suggest an explanation for the presence of any problems you noted. (Hint: What would happen if you used an improper flat prior on $\log \tau$?)

Total: 28 pts

[1] Ordinarily, autocorrelation plots are not used for chains that have not converged, but you should produce them here even if there was no convergence.