Homework 1 – Text Answers

Disclaimer: I made a bit of a mistake and didn’t read to the bottom of the homework document before writing and running all of my code. Therefore, my plots include all of the model outputs for each step, including those which did not converge! I believe a simple fix to this would be to add a line of code in my ‘for’ loop to check whether all Rhat values are equal to 1 (and only add results to the dataframe if the condition is met). Unfortunately I don’t have time to rerun all of the code so apologies for that! None of the results discussed below are based on models that don’t converge (this is probably only applicable in the case of some of the outilers in my plots).

Step1

1 – Parameter values successfully returned for both models—note however that the accuracy is greater for the simpler model, and that general the sigma/intercept parameters are more accurately estimated than slope parameter(s).

Step 2

1 – Reducing the size of the data set decreases the accuracy of all estimates (unsurprisingly). This effect is worse for slope parameters than for sigma/intercept parameters. The more complex model is generally less accurately estimated than the less complex model (also unsurprisingly). My mathematical intuition for why slope/higher order parameters are more difficult to estimate is not great, but a quick google search tells me that this is because outliers have more of an effect on slope estimation than on intercept/sigma estimation. For small datasets, outliers would be expected to have a more significant effect overall than in a large dataset. For two-way interactions, I would expect the influence of outliers to be even more serious. From a mathematical standpoint this makes sense, because if you are interacting a continuous and discrete (two-level) predictor, you are effectively calculating two slopes (one for the control level, one for the treatment level), each of which is using only *half* the total sample size for estimation (because only half of the datapoints are control and half are treatment). As the number of predictors in an interaction increases (e.g., 3-way, 4-way) or the number of levels in a discrete interaction increase (e.g., 3 treatment levels or 4 treatment levels) I would expect the accuracy to decrease even further.

Step 3

Unsurprisingly, increasing the error term decreases the accuracy of parameter estimation. This is because the signal to noise ratio in your data is lower (same effect size = same signal, but increasing sigma increases how noisy the data is). A lower signal to noise ratio makes it more difficult to detect and parametrize the effect size.

**Step** 4 – I am interested in using the carnivore teeth dataset, if possible!