Coding in advance of the March 25, 2019 class

Here we analyze the same data set as for the previous coding assignment (which we reproduce as data8_1.txt), using the same model as before, but we analyze it with different priors and also using marginalization. See coding07.pdf for details about the analysis and model setup.

Your tasks:

1. First we will test the effect of priors. Recall that last time, you assumed that the power law b was equally probable in the range $b = -2$ to $b = 0$ (but you skipped $b = -1$ because that involves logarithms). Do exactly the same analysis as before, but assume that in the $b = -2$ to $b = 0$ range the prior probability density is proportional to b^2, so that (for example) at $b = -2$ the prior probability density is proportional to 4, whereas at $b = -0.5$ the prior probability density is proportional to 1/4. Again, calculate the value of b, $b_{\rm max}$, which maximizes the log posterior, as well as the values of b below and above $b_{\rm max}$ that produce a log posterior 0.5 below the maximum. How do these compare with the values you obtained using a flat prior?

2. Now we will determine the effect of marginalization. We will return to the previous prior on b, i.e., that it is equally probable in the range $b = -2$ to $b = 0$ (skipping $b = -1$ as always). But rather than fixing a to the value, call it a_0, that gives a total number of stars equal to the observed number (which is 20 for our data set), we will impose a prior that a can with equal probability be anywhere between $a_0/2$ and $2a_0$. Now, in order to obtain our final posterior for b, we need to *integrate* the posterior (**not** the log posterior!) over all allowed values of a for the given b. Report the value of b, $b_{\rm max}$ that maximizes that integrated posterior, and the values of b below and above $b_{\rm max}$ that give a log posterior 0.5 below the maximum. How do these compare with the values you obtained when you fixed the value of a for a given b?

Good luck!