Suppose that we have focused on location and species

Suppose that we have 3 groups and that, after we remove the i-th individual, we have .

Furthermore, after removing the i-th individual, we also have and

We can integrate out and hopefully the resulting expression will lead to more rapid convergence.

Here is the expression after integrating out :

We can write this more explicitly as:

In this equation, the integrated multinomials are in red and the Poissons are in black.

So far, we only know up to a proportionality constant. To determine the actual value of this probability, we need to normalize it by dividing this quantity by

Let’s deal with the multinomial first, assuming we just have two groups to avoid this getting too big:

Start cutting pieces:

Use factorial and gamma function rules to simplify:

This suggests the following expression for the integrated multinomial piece:

Let’s deal with the Poisson part:

Let’s start cutting some pieces:

This suggests the following expression for the Poisson piece:

Combining these two pieces, we get: