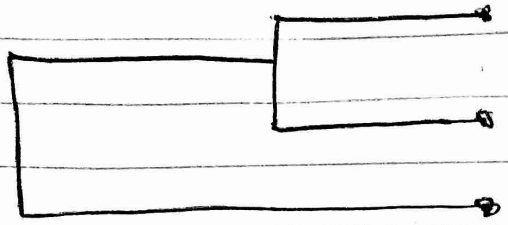

M_e = max extinct species = $C \cdot N$

N ← # species at present

C ← convenient constant

Data augmentation scheme

$$N_e \tilde{\sim} \text{Uniform}(\{0, 1, \ldots, M\})$$

N_e = # extinct species to be added.

$T_1^S \ldots T_{N_e}^S$ speciation times of the extinct species are drawn

$$T_i^S \sim \begin{cases} \text{Un}[0, T] \\ T \cdot \text{Beta}(\alpha, \beta) \end{cases}$$

where $\alpha = 1.3$

$\beta = 1.8$

Then draw $T_1^E \ldots T_{N_e}^E$ extinction times

$$T_i^E \sim \text{Un}[T_i^S, T]$$

Data augmentation density

T_0 = observed tree of extant species

T_a = augmented tree

We want $g(T_a \mid T_0)$

1. Calculate
   N_e = # extinct species
   M = C × # extant species
2. density

$$\frac{1}{M+1} \times \left(\frac{1}{T}\right)^{N_e} \times \prod_{i=1}^{N_e} \frac{1}{T - T_i^s}$$

× topology component

$$\prod_{i=1}^{N_e} \frac{1}{n_i}$$

where n_i = number of species present at T_i^s