



Bayes' theorem

$$\begin{array}{c}
 \text{posterior} \swarrow \\
 P(\text{parameters} \mid \text{data, model}) = \frac{
 \begin{array}{c}
 \text{likelihood} \downarrow \\
 P(\text{data} \mid \text{parameters, model})
 \end{array}
 \begin{array}{c}
 \text{priors} \downarrow \\
 P(\text{parameters} \mid \text{model})
 \end{array}
 }{
 \begin{array}{c}
 \text{marginal probability of the data} \nearrow \\
 P(\text{data} \mid \text{model})
 \end{array}
 }
 \end{array}$$

Putting everything together

$$\begin{array}{c}
 \text{posterior} \downarrow \\
 P(
 \begin{array}{c}
 \text{tree} \\
 \text{parameters}
 \end{array}
 \mid
 \begin{array}{c}
 \text{data} \\
 \text{fossil ages}
 \end{array}
) =
 \begin{array}{c}
 \text{probability of the character} \\
 \text{data given everything else*} \downarrow \\
 P(
 \begin{array}{c}
 \text{data} \\
 \text{fossil ages}
 \end{array}
 \mid
 \begin{array}{c}
 \text{tree} \\
 \text{parameters}
 \end{array}
)
 \begin{array}{c}
 \text{probability of the timetree} \\
 \text{given the tree model} \downarrow \\
 P(
 \begin{array}{c}
 \text{tree} \\
 \text{parameters}
 \end{array}
 \mid
 \begin{array}{c}
 \text{data} \\
 \text{fossil ages}
 \end{array}
)
 \begin{array}{c}
 \text{priors on model parameters} \downarrow \downarrow \downarrow \\
 P(\lambda, \mu, \rho) P(\text{clock}) P(\text{substitution})
 \end{array}
 \end{array}
 \frac{
 }{
 \begin{array}{c}
 \text{marginal probability of the data} \nearrow \\
 P(
 \begin{array}{c}
 \text{data} \\
 \text{fossil ages}
 \end{array}
)
 }
 \end{array}$$

*the tree, the parameters and the tripartite model