Model Adequacy

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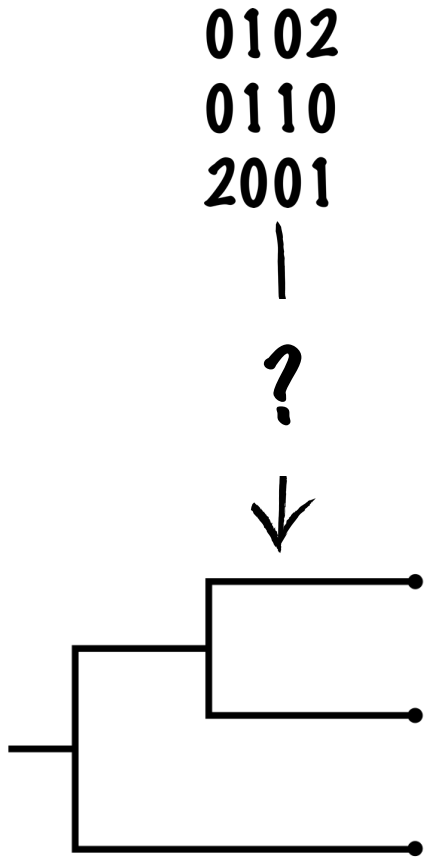
Model selection vs. Model adequacy

Take a bunch of different models and test which is the *best*

Gives the **relative** fit



Assess whether a model is capturing the evolutionary dynamics that generated the data

Gives the **absolute** fit

Model Adequacy

We know that none of our models are really true. Can we be sure that the chosen model captures the salient features of the evolutionary process and provides reliable inferences

Could the model and priors plausibly have given rise to the data

Allows us to ask whether **any** of our models are doing a good job describing the evolutionary processes that produced our data

Posterior Predictive Simulations

Empirical Data	
taxa 1	0 1 0 1 2 1
taxa 2	1 2 1 0 1 0
taxa 3	0 0 1 0 0 1
taxa 4	1 1 0 1 0 1

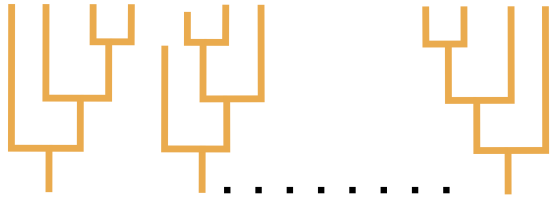
Höhna et al 2017

Posterior Predictive Simulations

Empirical Data						
taxa 1	0	1	0	1	2	1
taxa 2	1	2	1	0	1	0
taxa 3	0	0	1	0	0	1
taxa 4	1	1	0	1	0	1

1)

Standard MCMC inference while sampling from the posterior



Posterior Predictive Simulations

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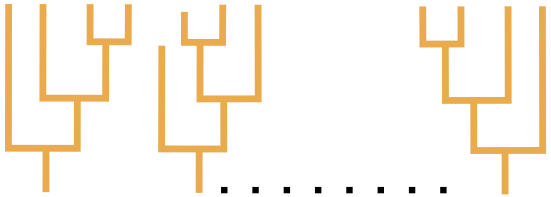
1)

Standard MCMC inference while sampling from the posterior



2)

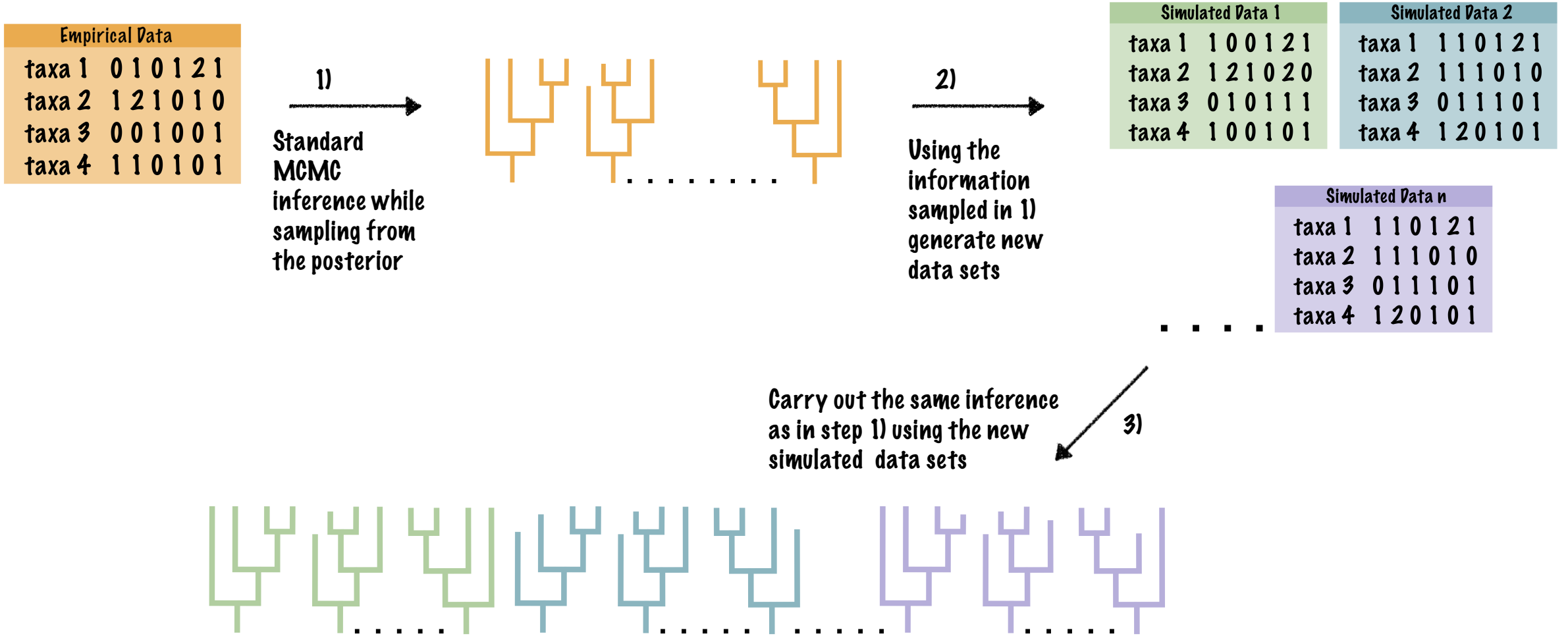
Using the information sampled in 1) generate new data sets

Simulated Data 1	
taxa 1	1 0 0 1 2 1
taxa 2	1 2 1 0 2 0
taxa 3	0 1 0 1 1 1
taxa 4	1 0 0 1 0 1

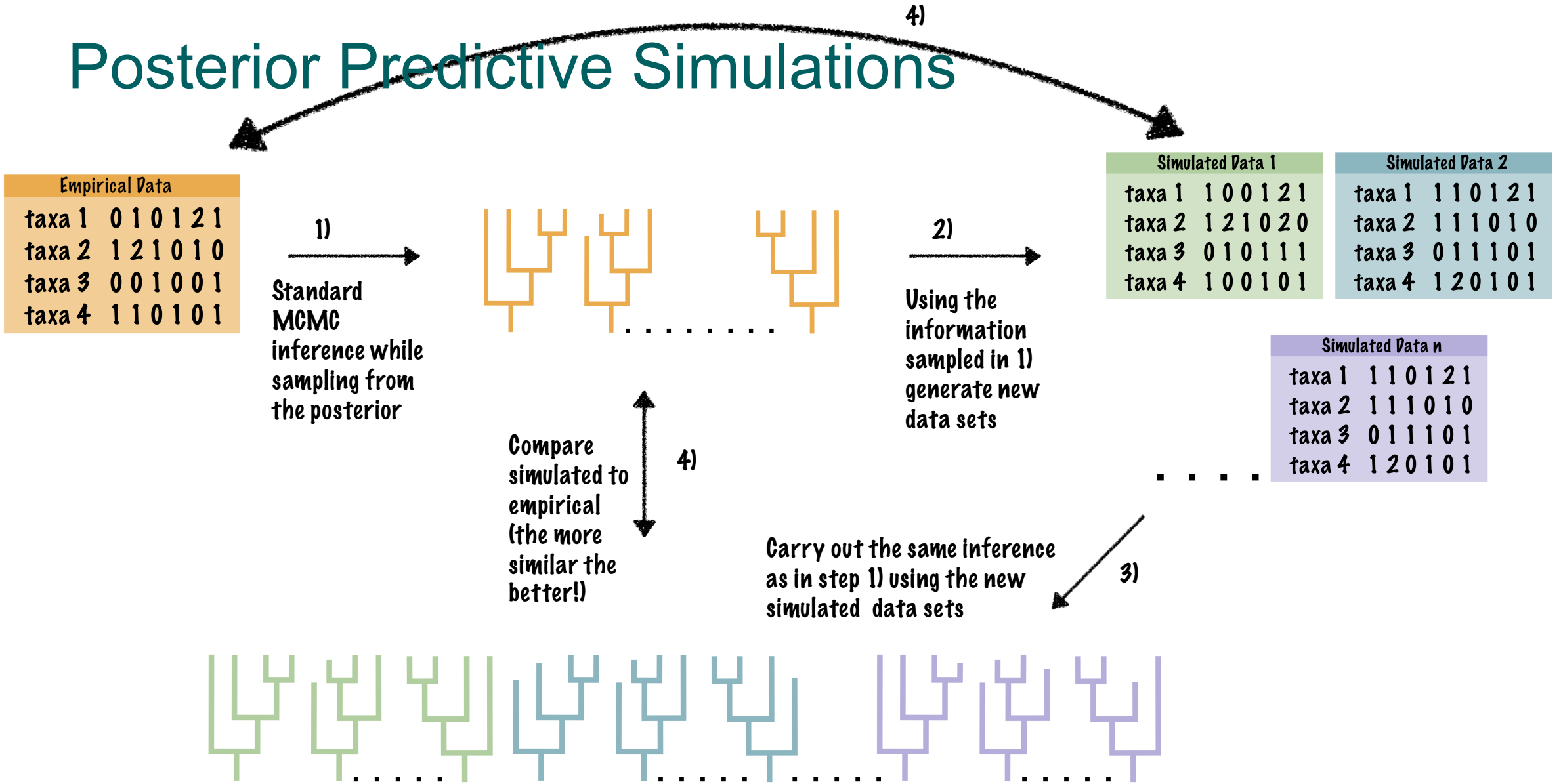
Simulated Data 2	
taxa 1	1 1 0 1 2 1
taxa 2	1 1 1 0 1 0
taxa 3	0 1 1 1 0 1
taxa 4	1 2 0 1 0 1

Simulated Data n	
taxa 1	1 1 0 1 2 1
taxa 2	1 1 1 0 1 0
taxa 3	0 1 1 1 0 1
taxa 4	1 2 0 1 0 1

Posterior Predictive Simulations



Posterior Predictive Simulations



Test Statistics

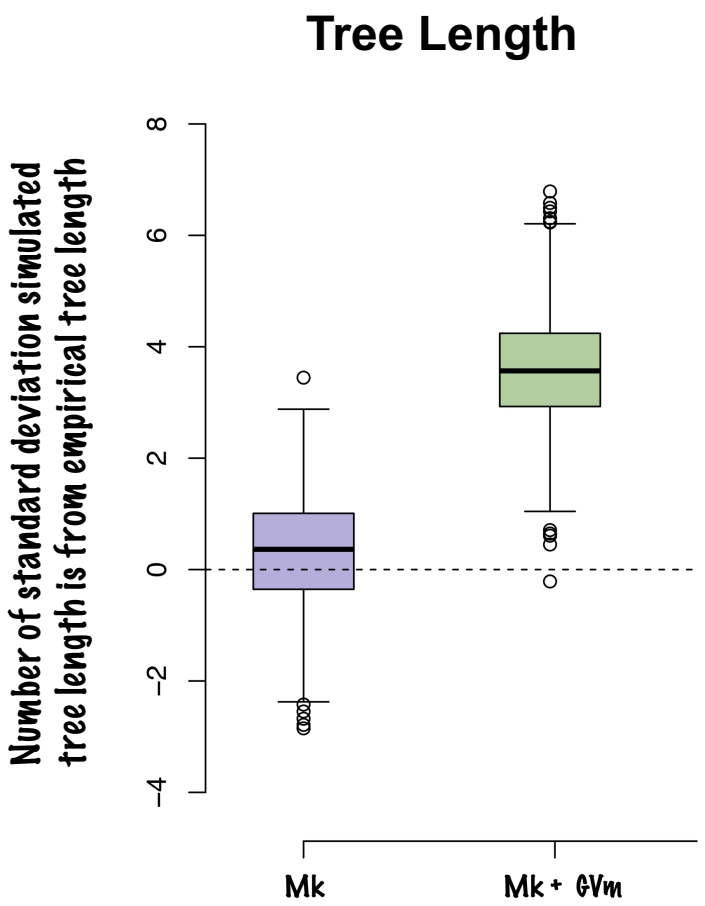
How can we compare trees and morphological matrices?

Need to get test statistics that compare the difference

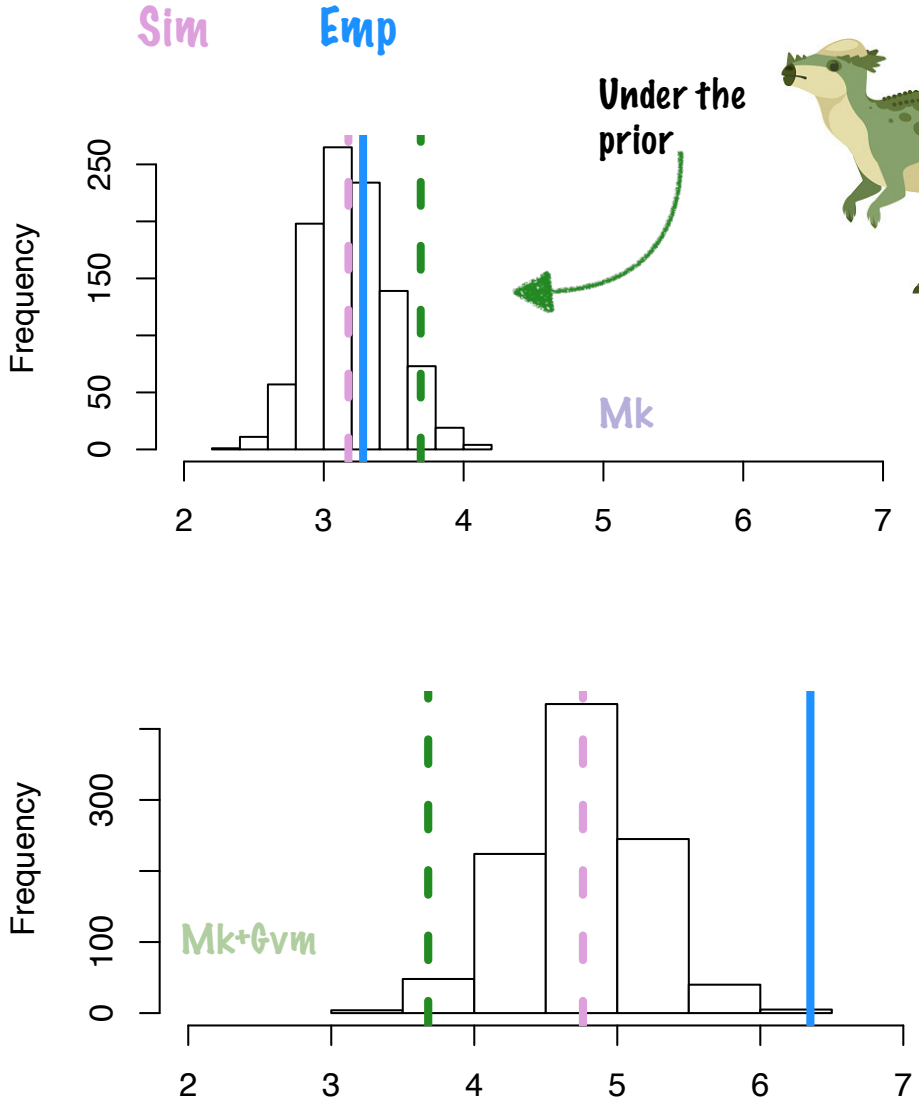
More work has been done for molecular data – easier to compare

To compare simulations to empirical data we use effect sizes.

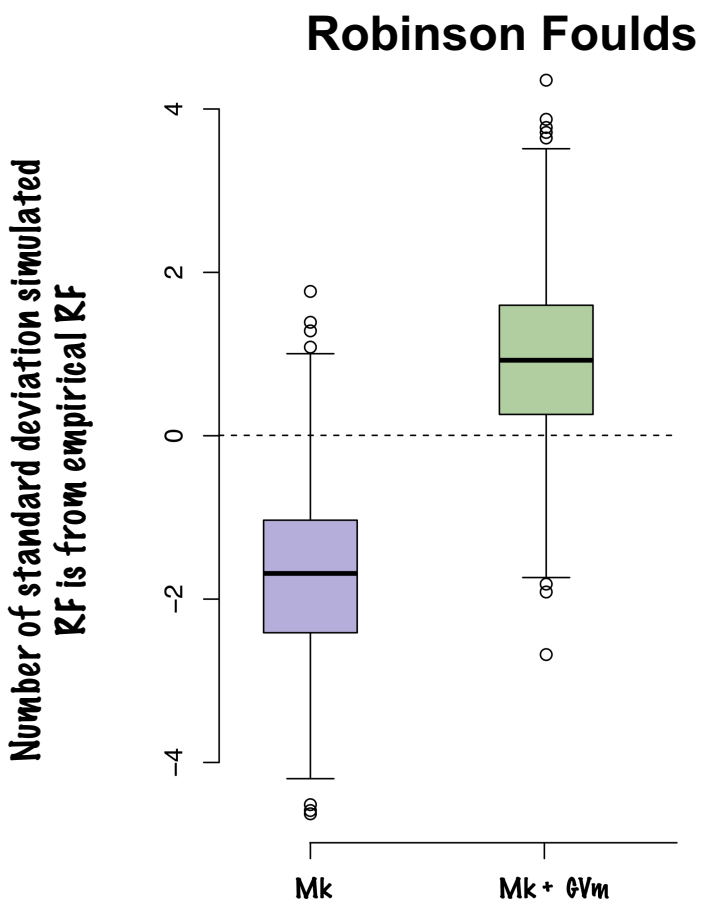
Test Statistics



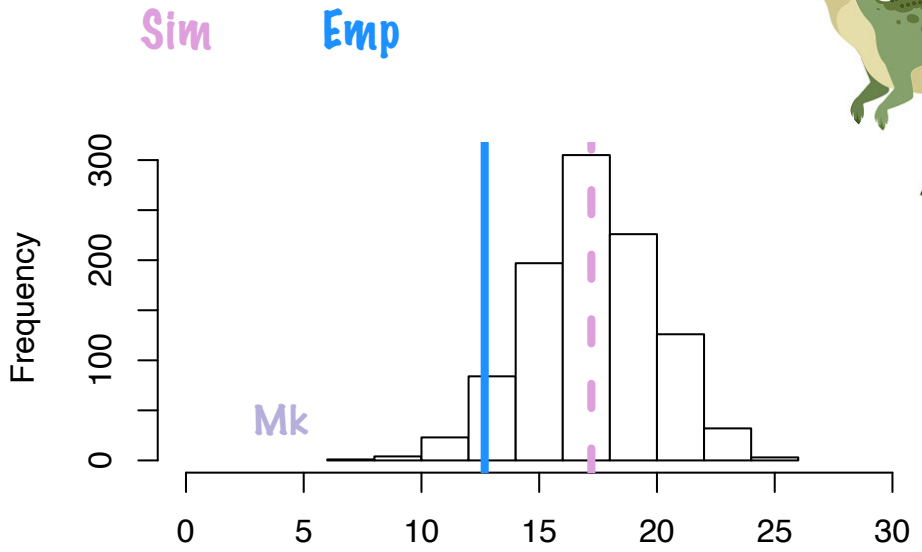
over estimated using the more complex model

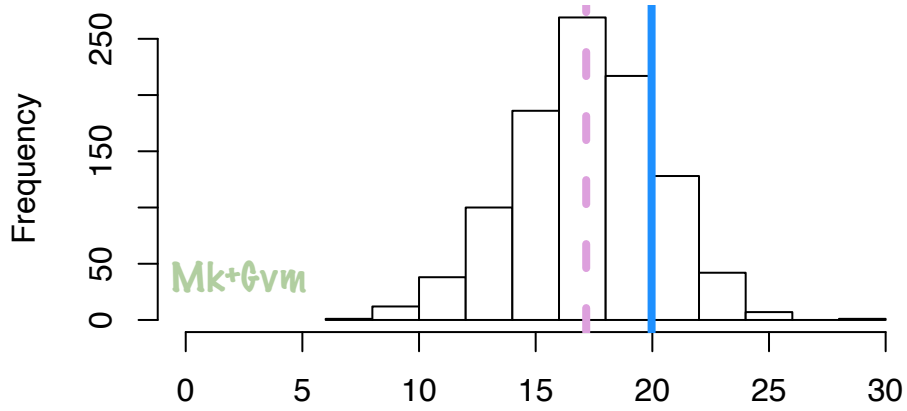


Test Statistics

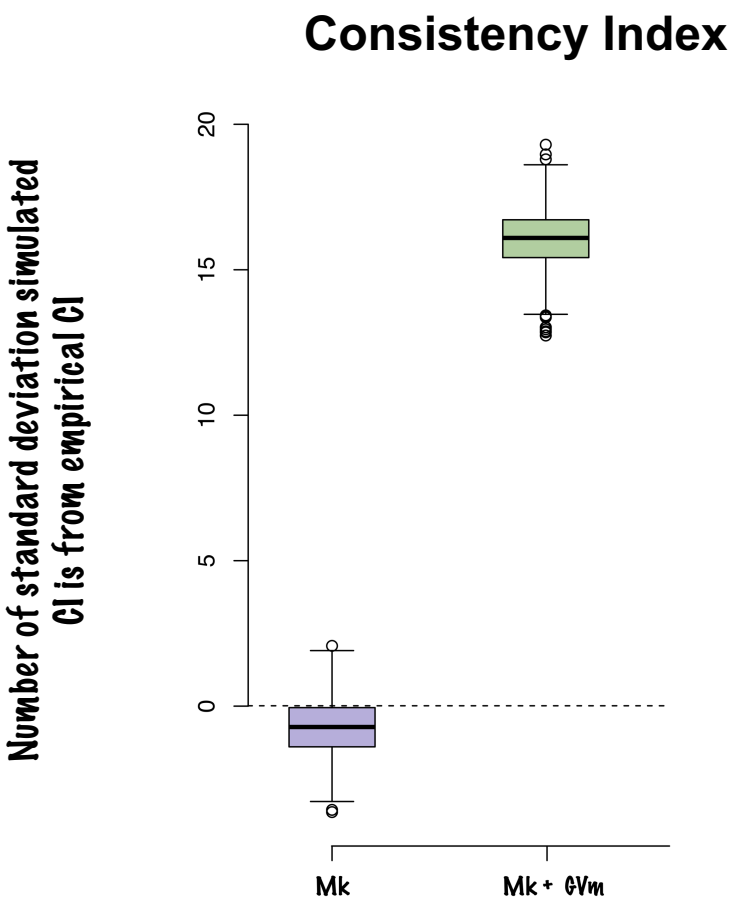


Both models produced similar RF results

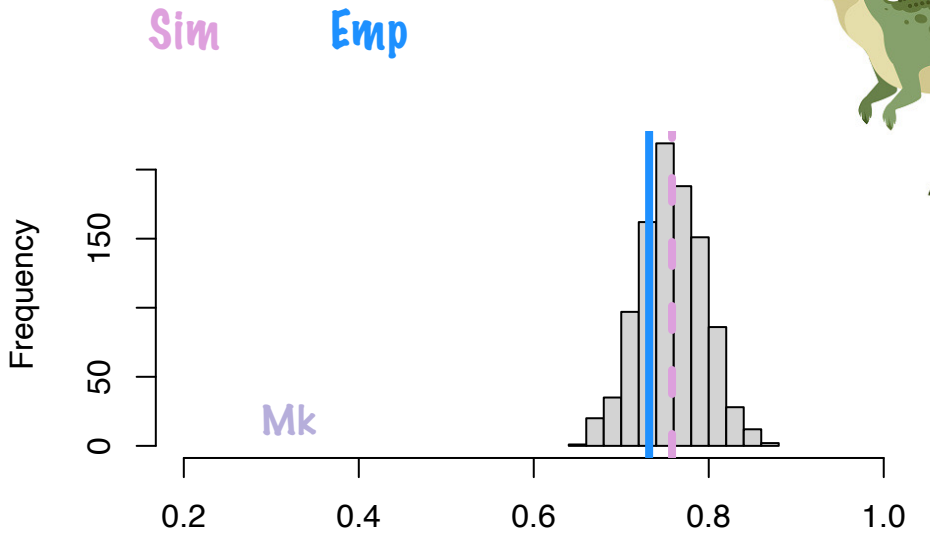


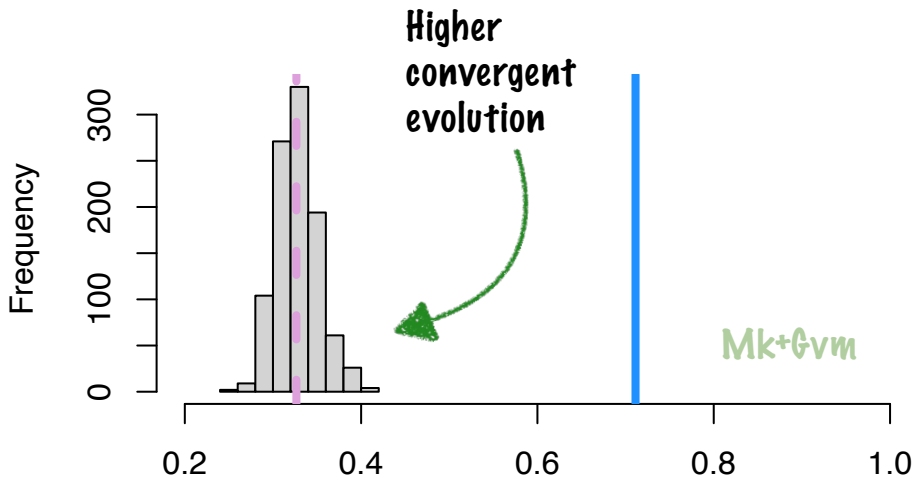


Test Statistics



The more complex **over** estimated convergent evolution





More test statistics

Tree length
Robinson Foulds
Consistency Index
Retention Index
Hamming distances
Multiple distance metrics

Exercise 3

Check if either of the two models you chose for exercise 1 fit your data using a model adequacy approach