A new phylogenetic comparative method: detecting niches and transitions with continuous characters.

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UC Davis

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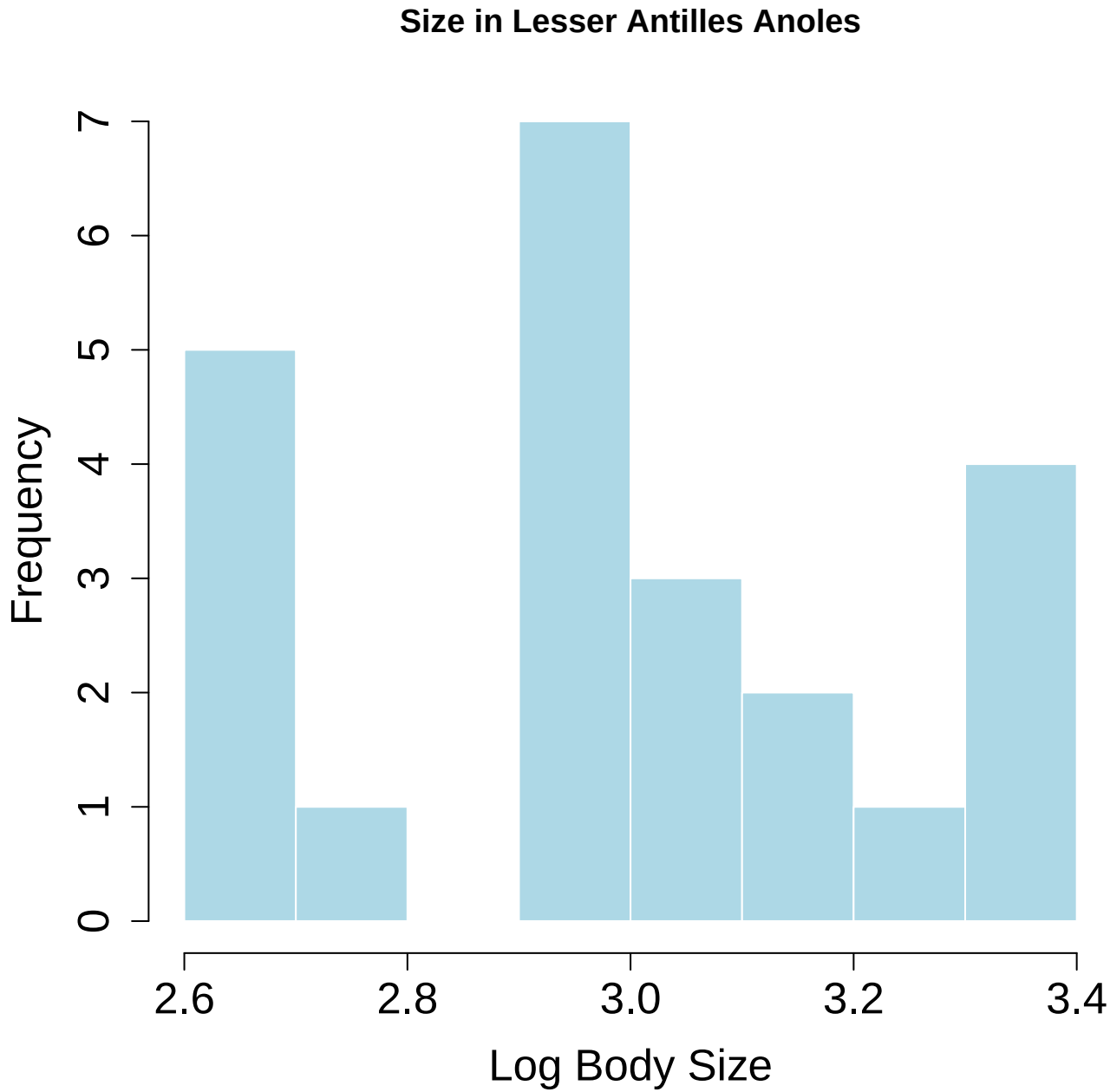

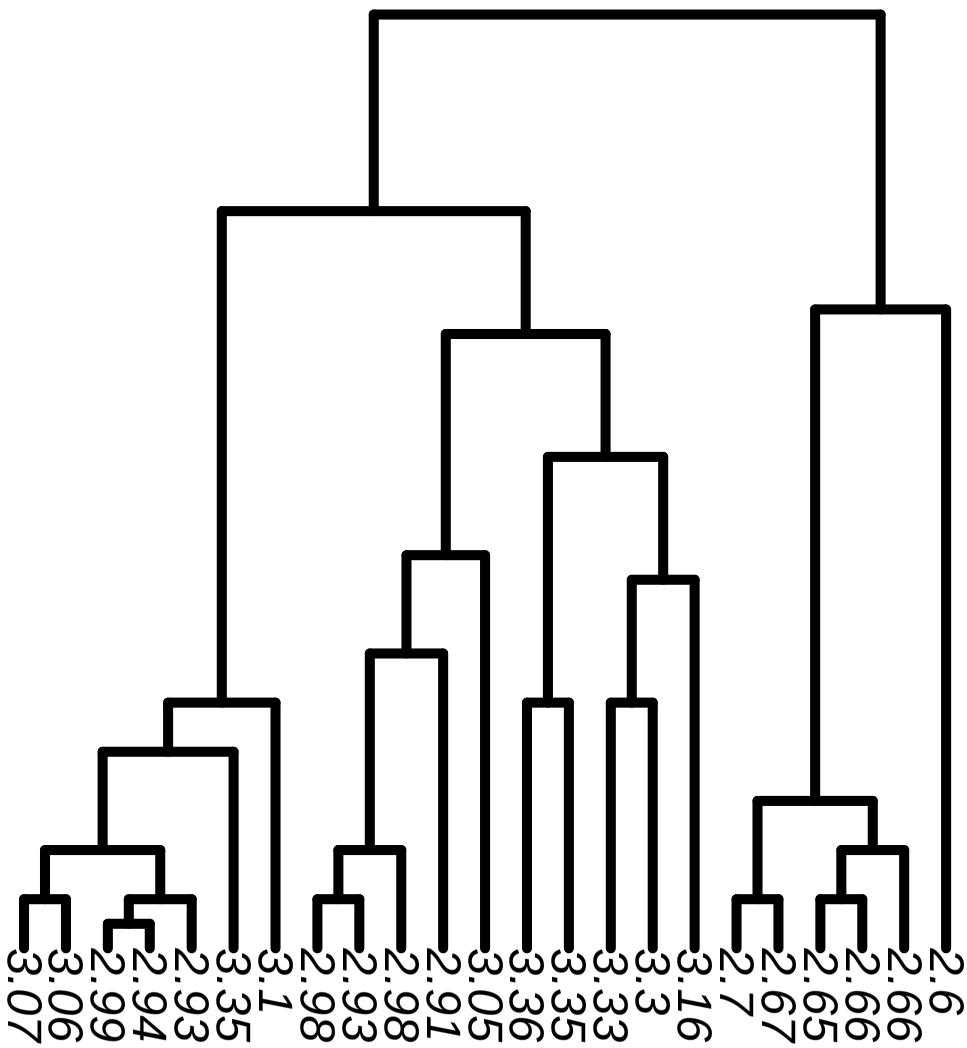

Goals

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1. Demonstrate selecting models by information criteria is inadequate

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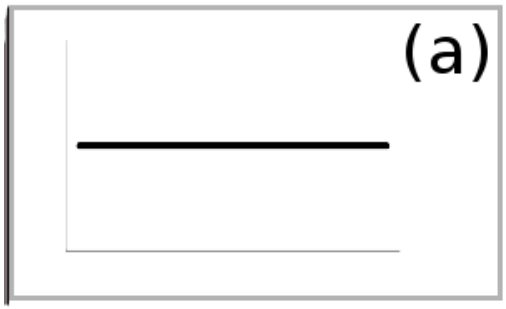
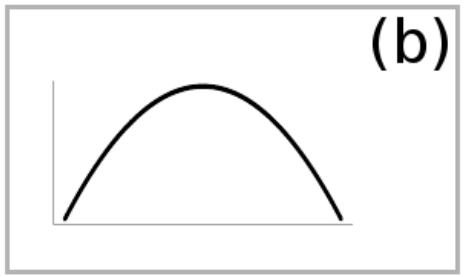
2. I'll propose a more robust framework

Types of models



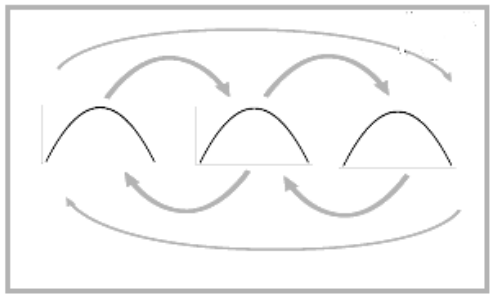
Brownian Motion

$$dX = \sigma dB$$



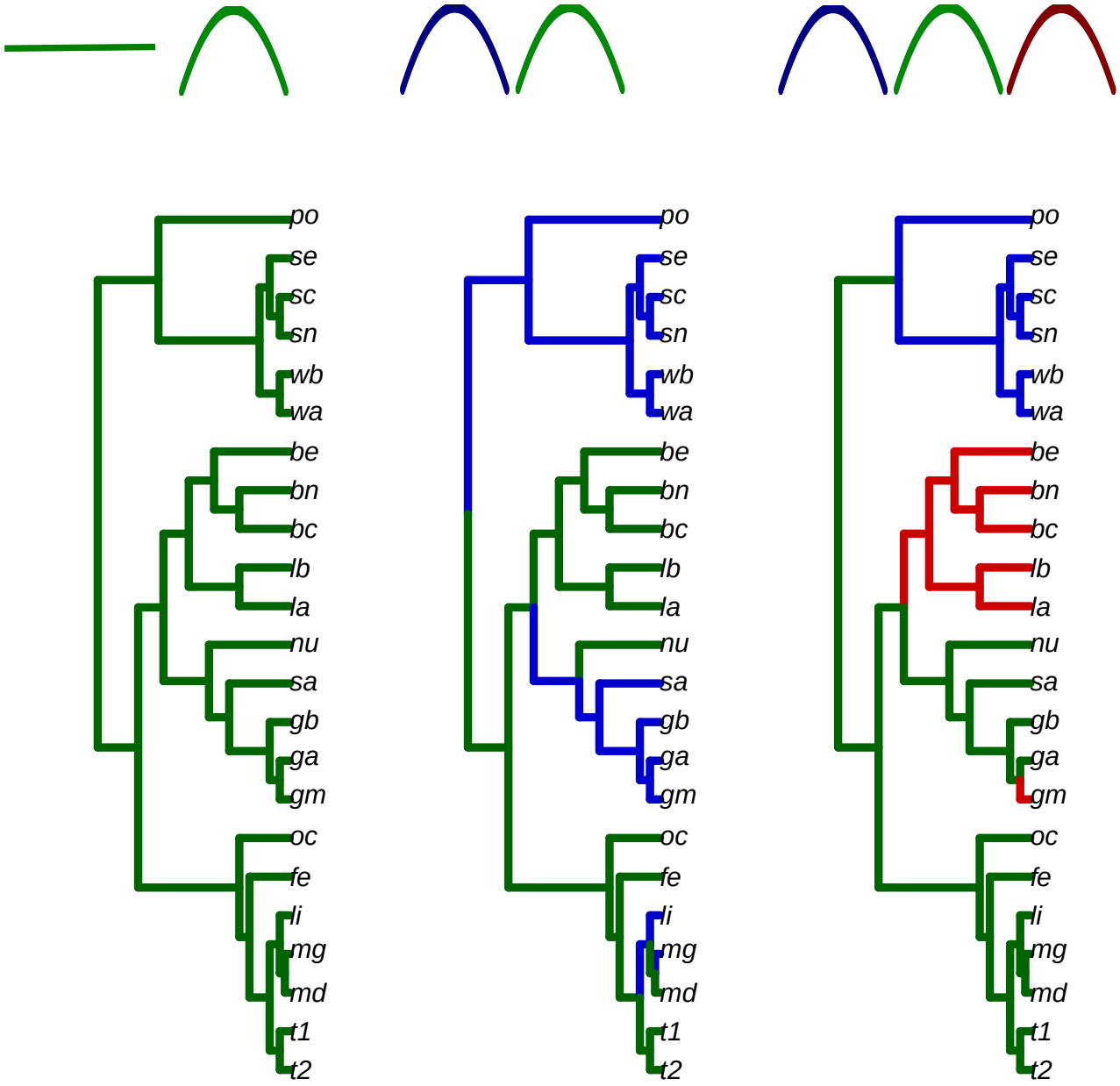
Ornstead-Uhlenbeck

$$dX = \alpha(\theta - X)dt + \sigma dB$$

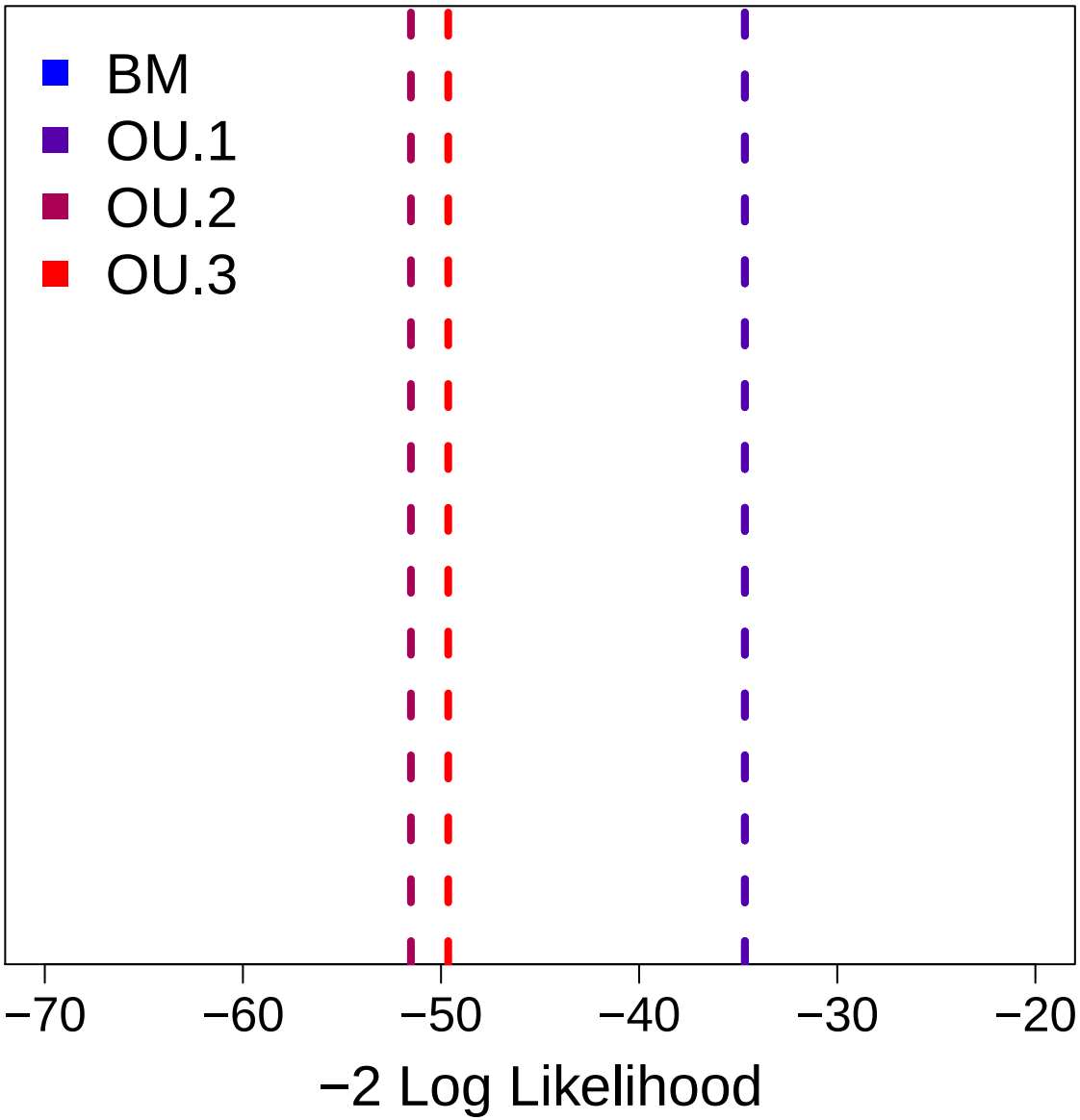


Regimes

Comparing Models

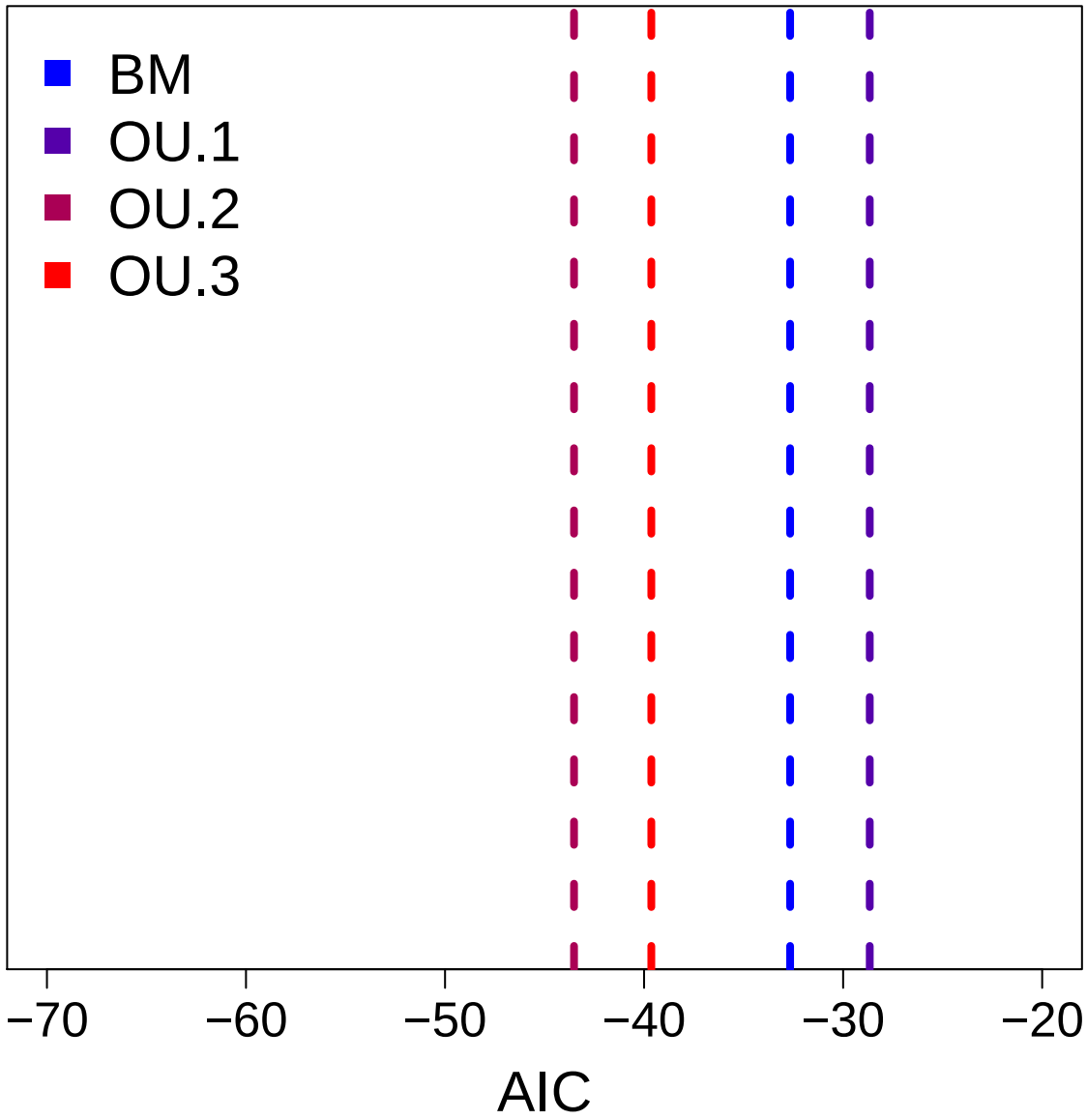


Comparing Models



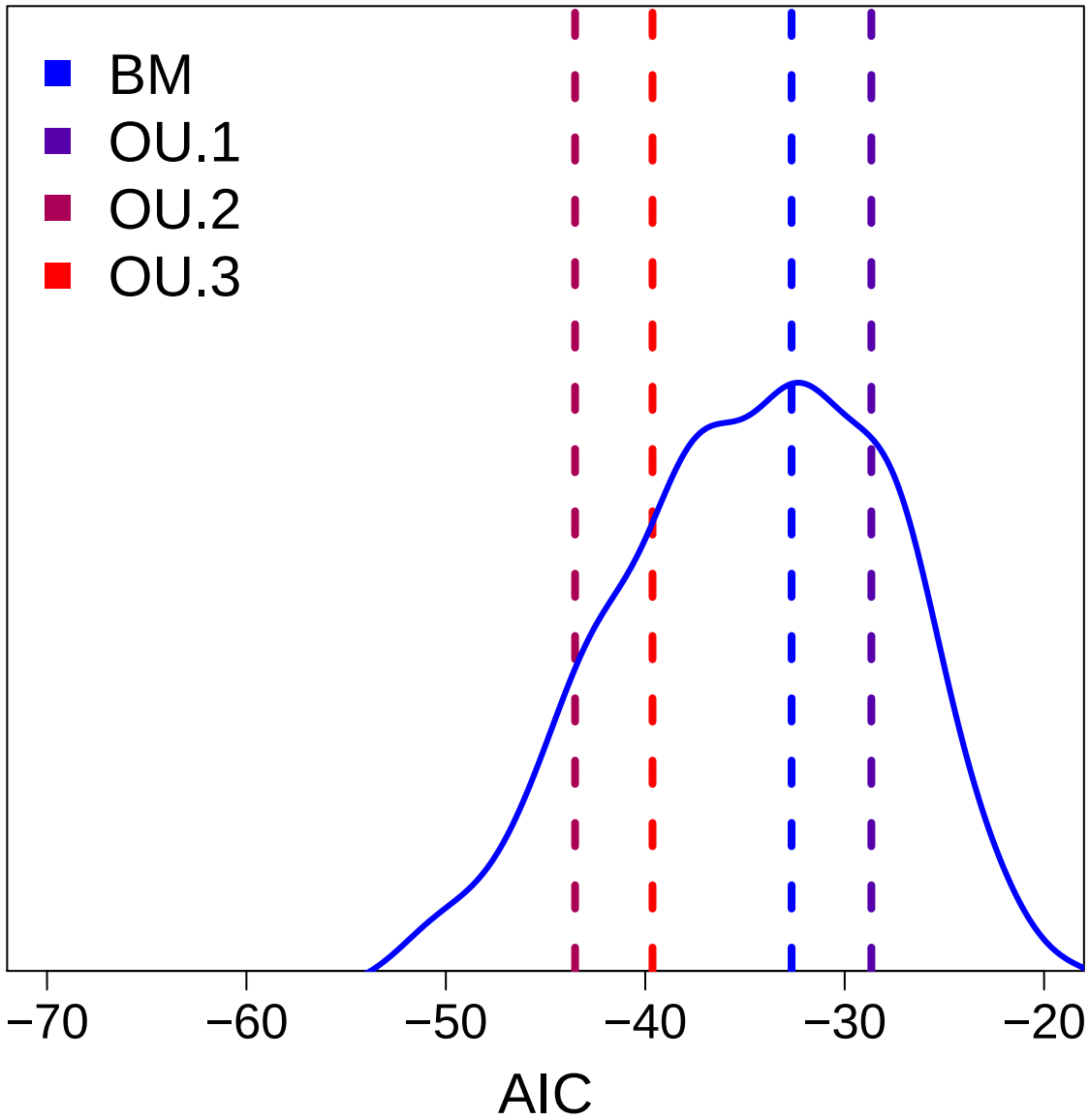
(Better Scores)

Comparing Models: AIC



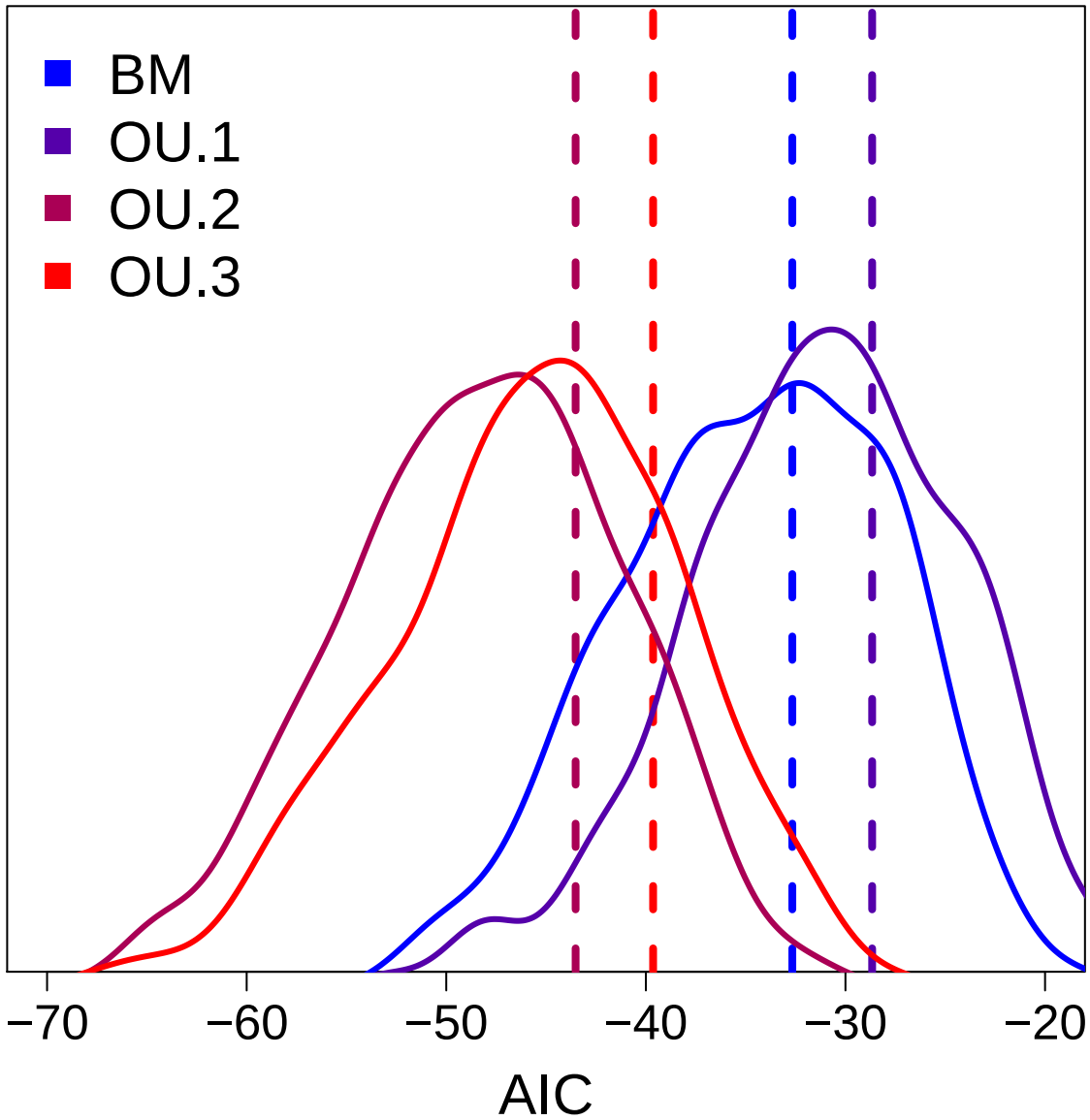
(Better Scores)

Comparing Models: Estimating Uncertainty



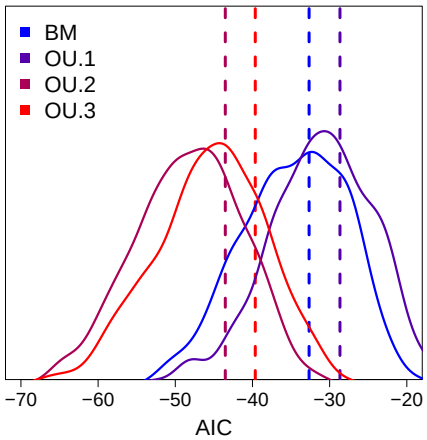
(Better Scores)

Comparing Models: Uncertainty dominates

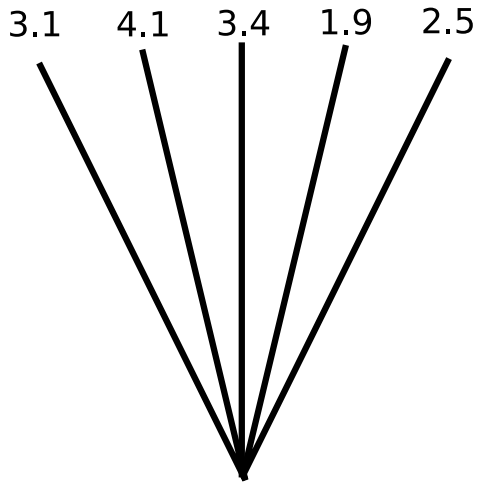


(Better Scores)

Sources of this uncertainty

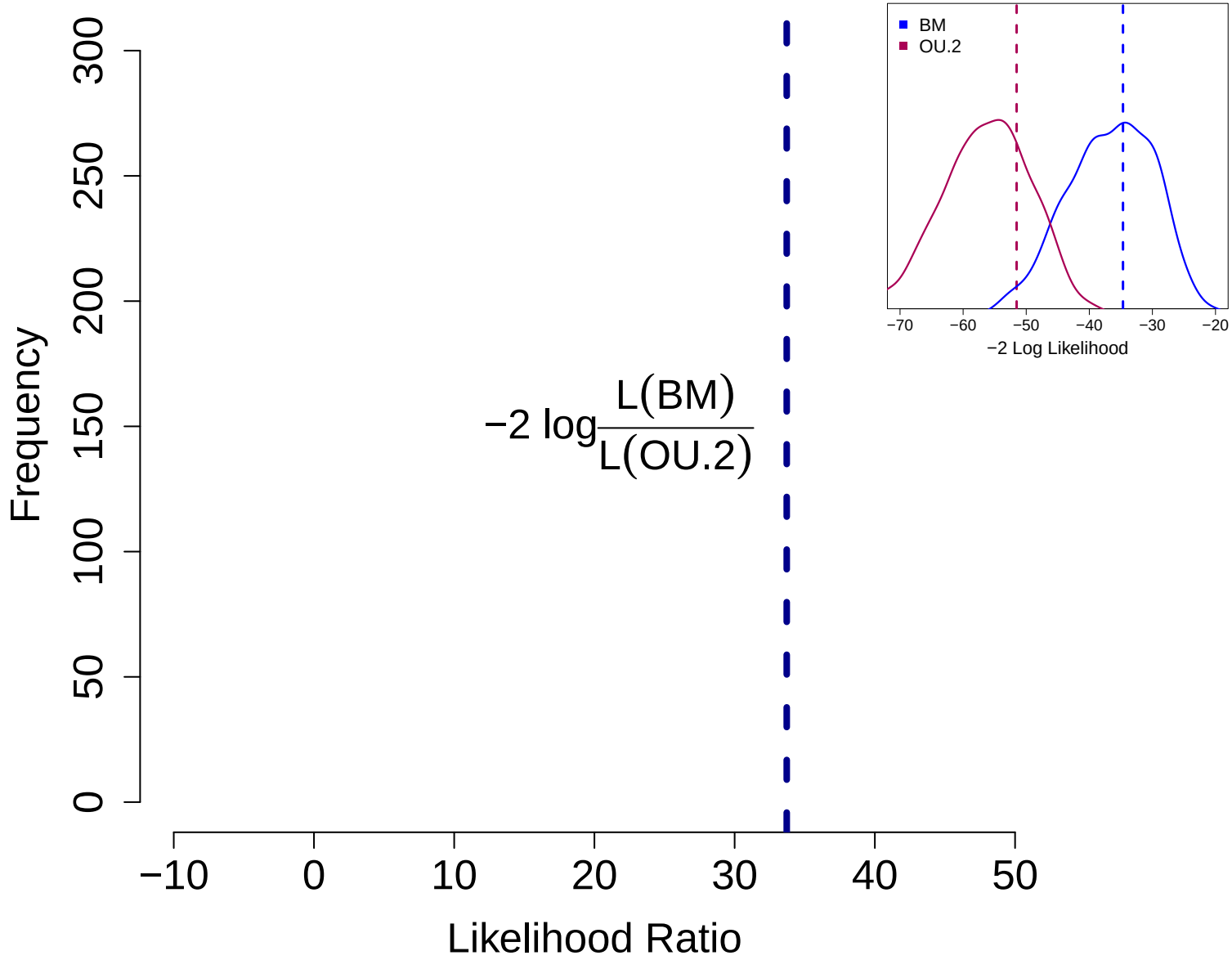


- Small datasets
- Uninformative topology
- Model details (*i.e.* high rates)

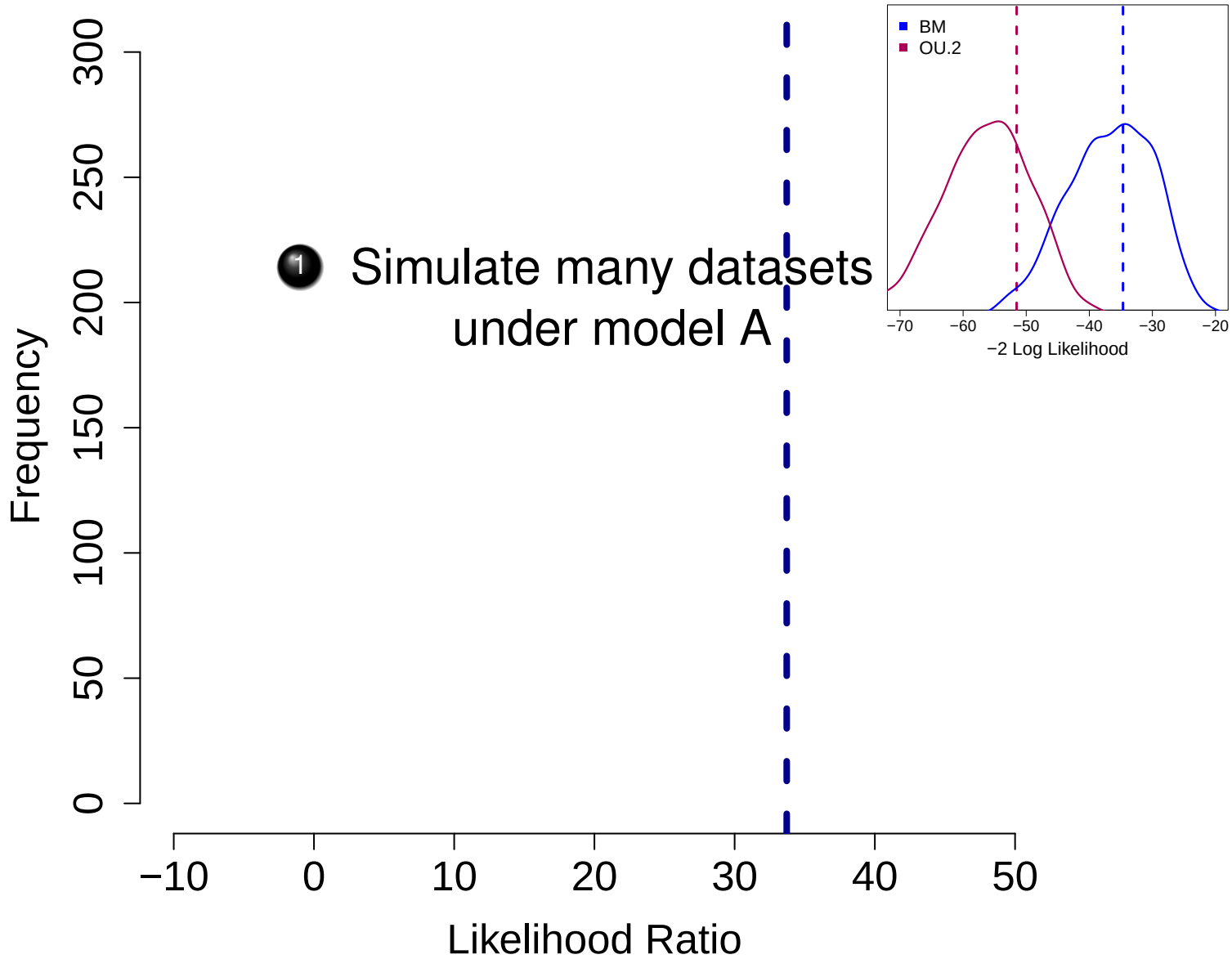


Information criteria alone may be misleading

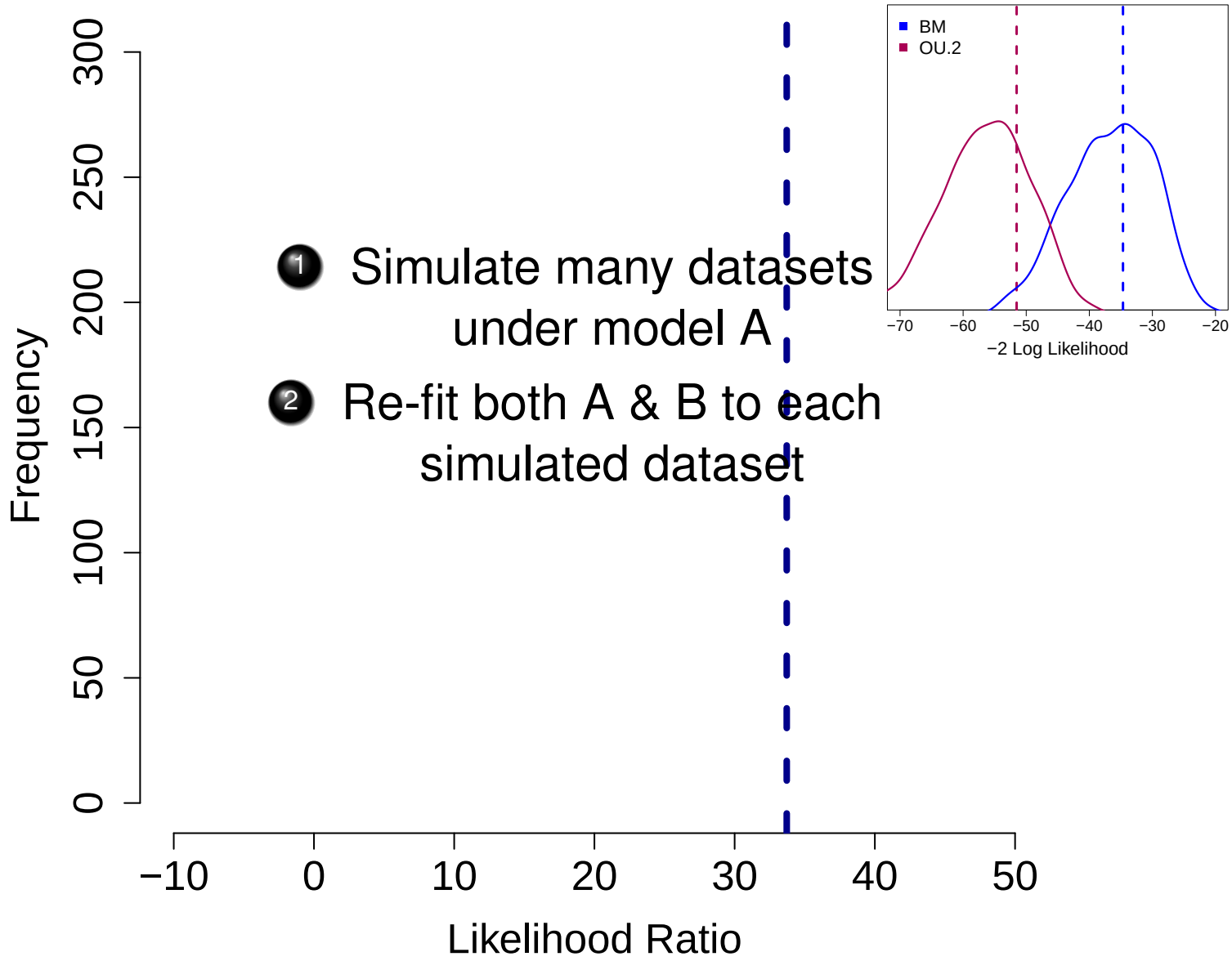
A Better Way: Comparing Models Directly



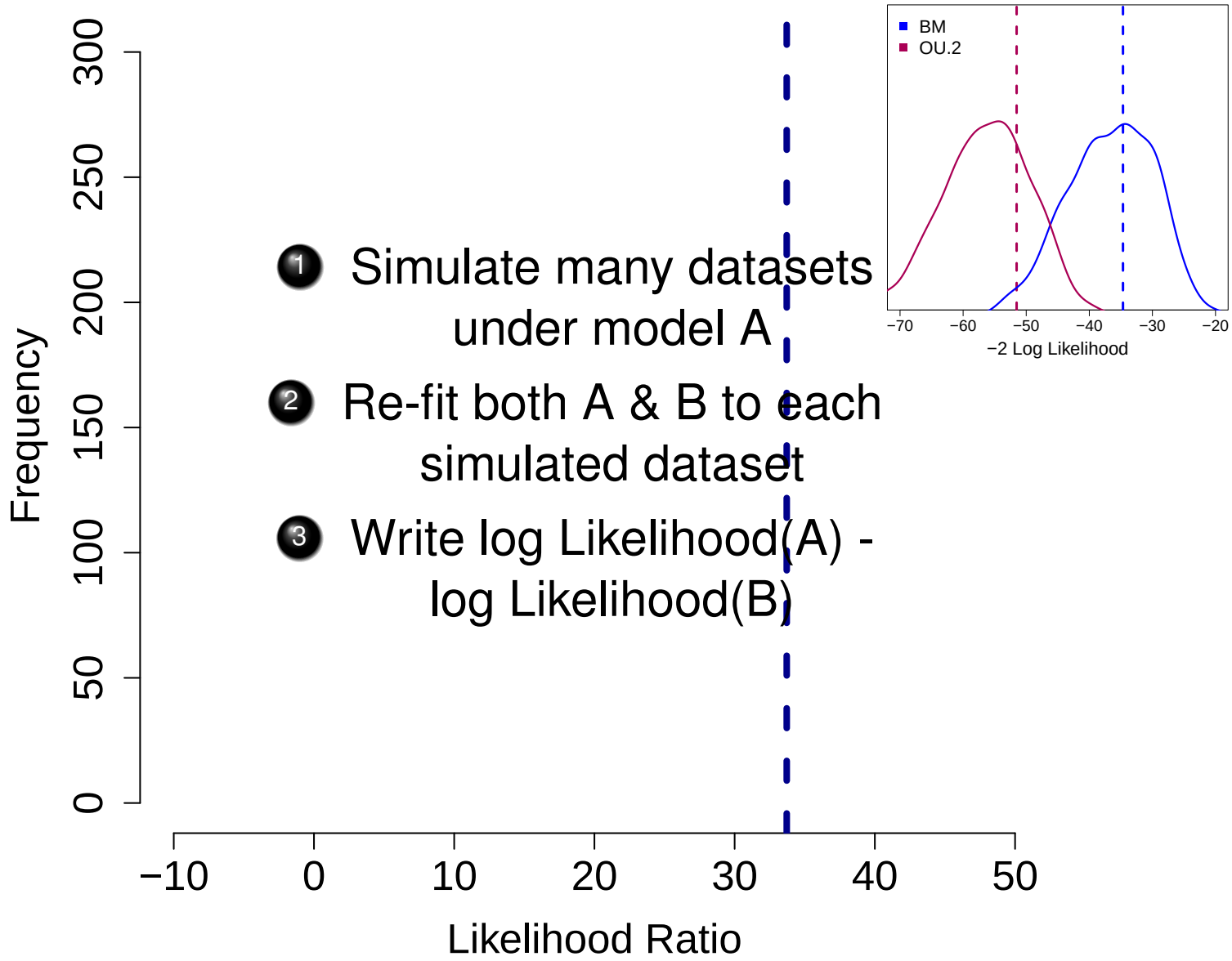
Method



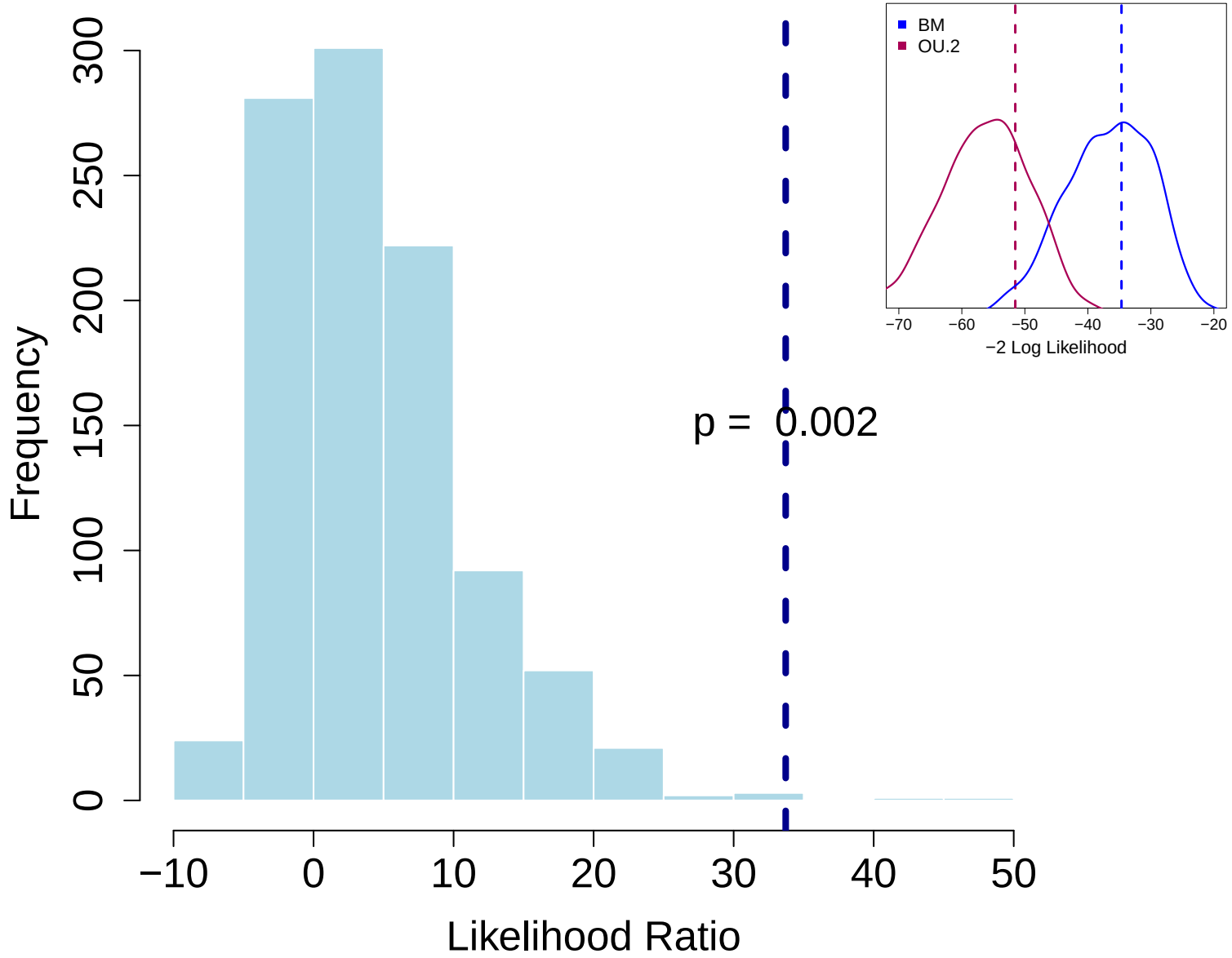
Method



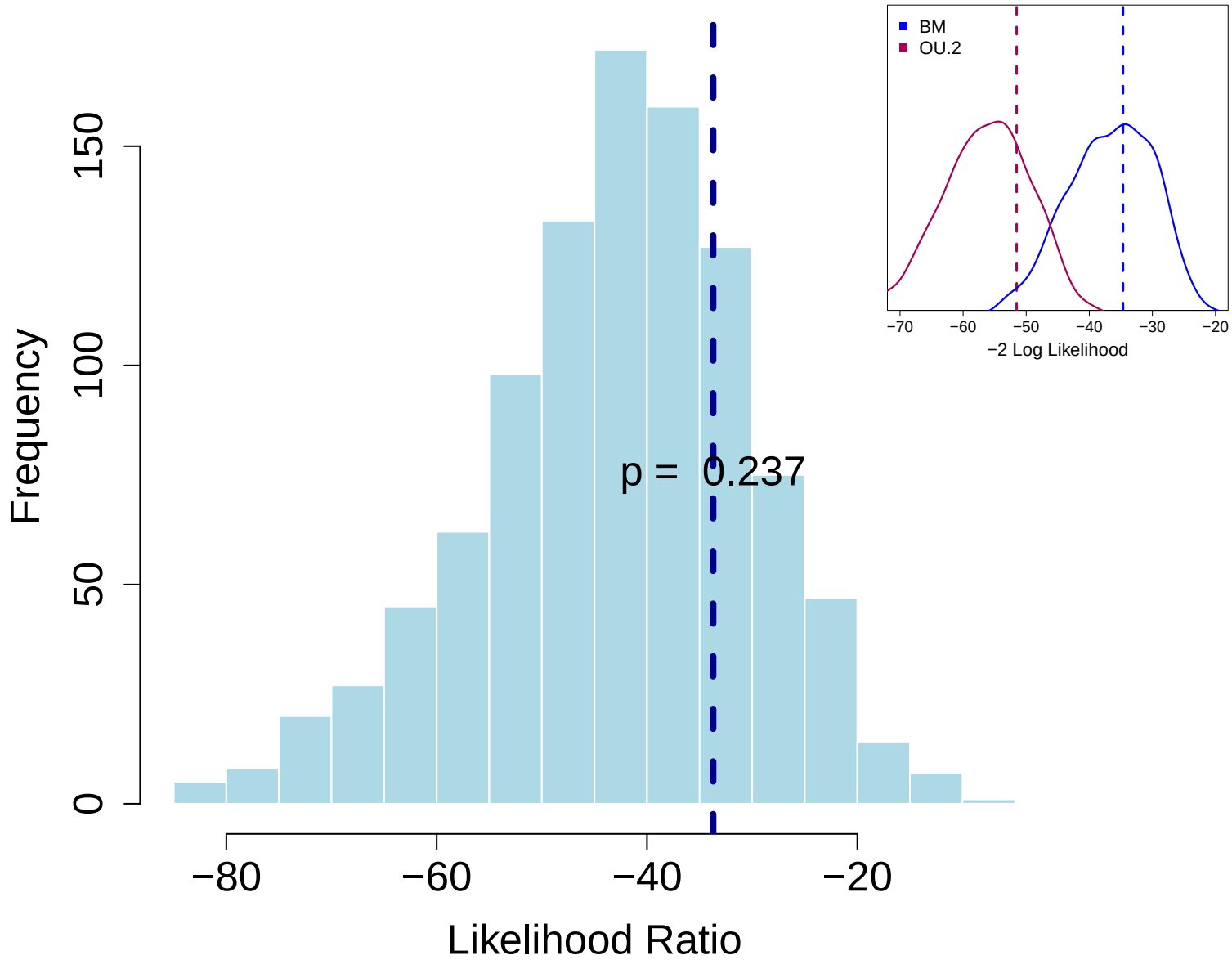
Method



BM vs OU.2

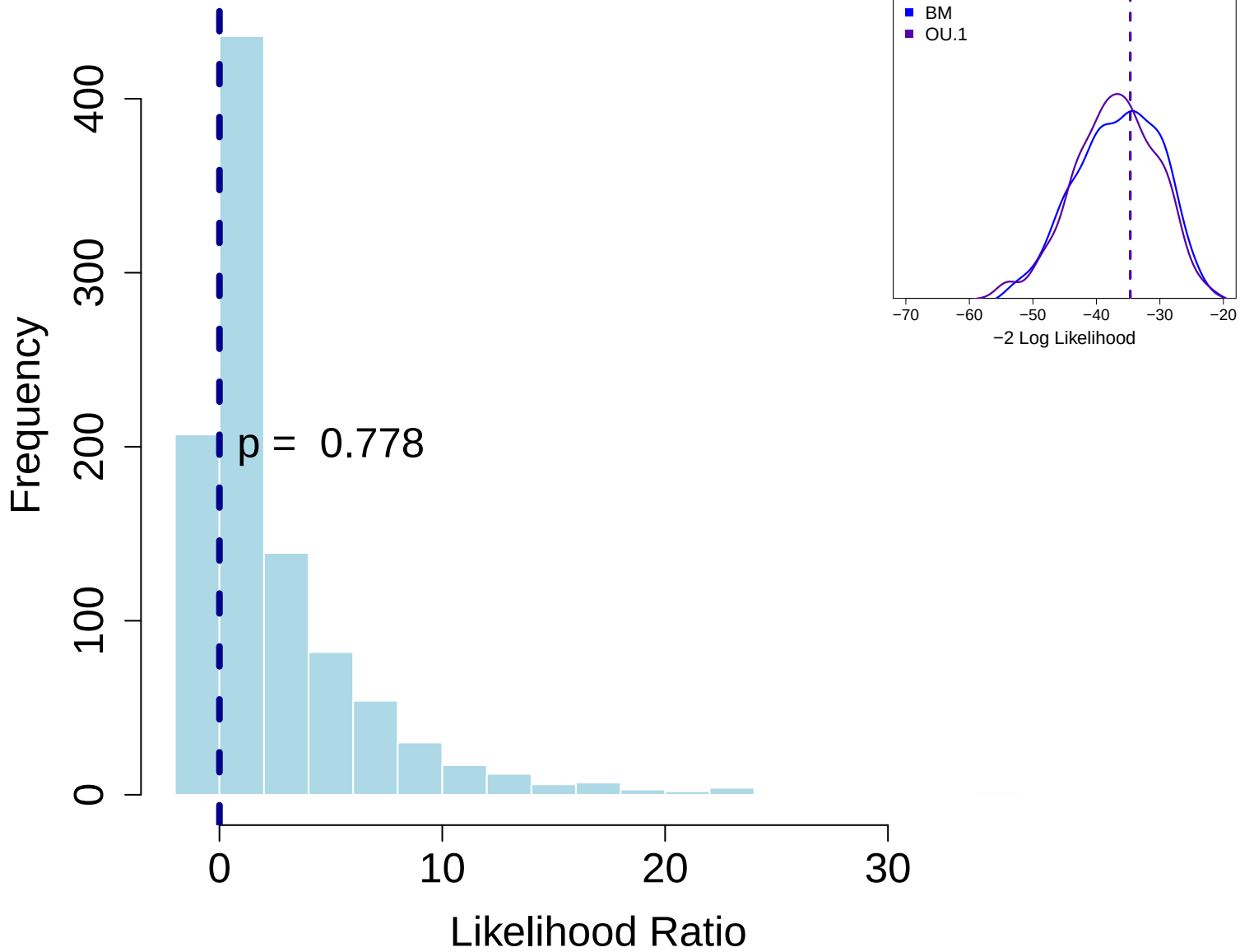


OU.2 vs BM: Simulating under OU.2

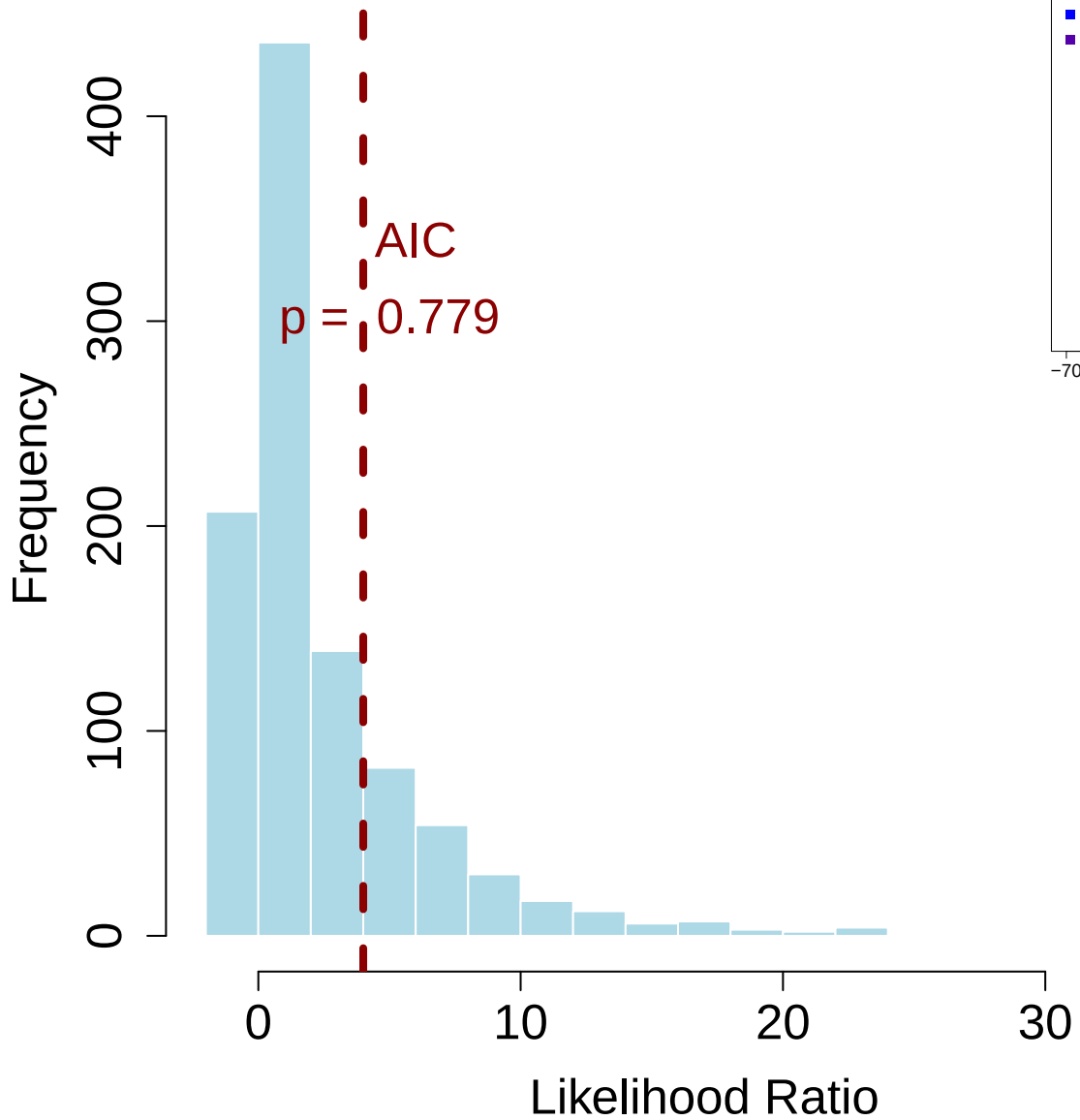


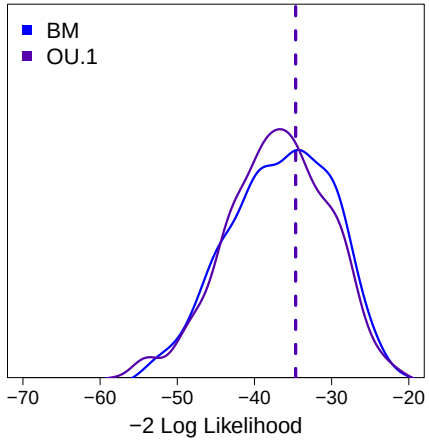
Model A rejects Model B.
Model B doesn't reject Model A.

How about two very similar models? BM vs OU.1



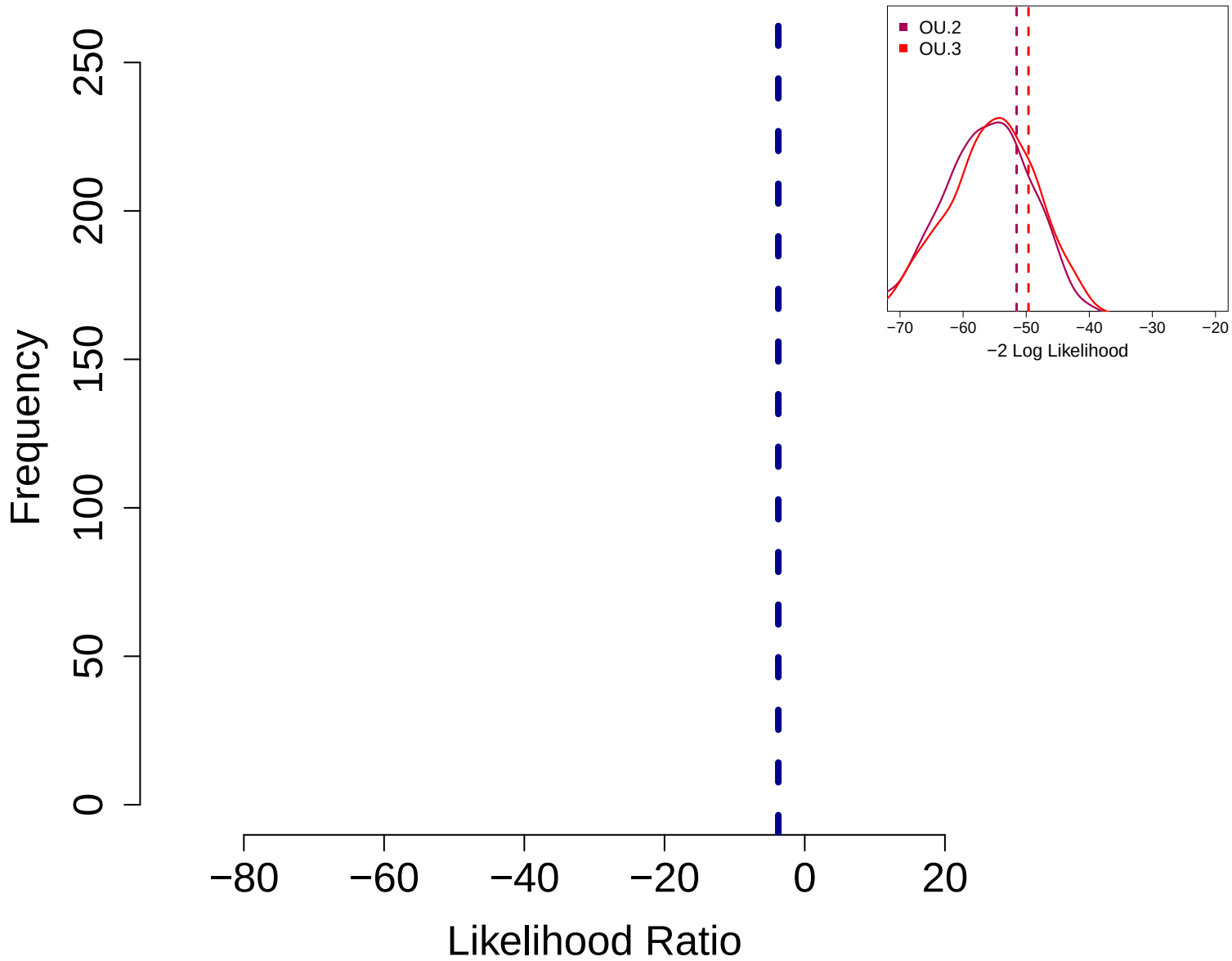
How would AIC rule compare?



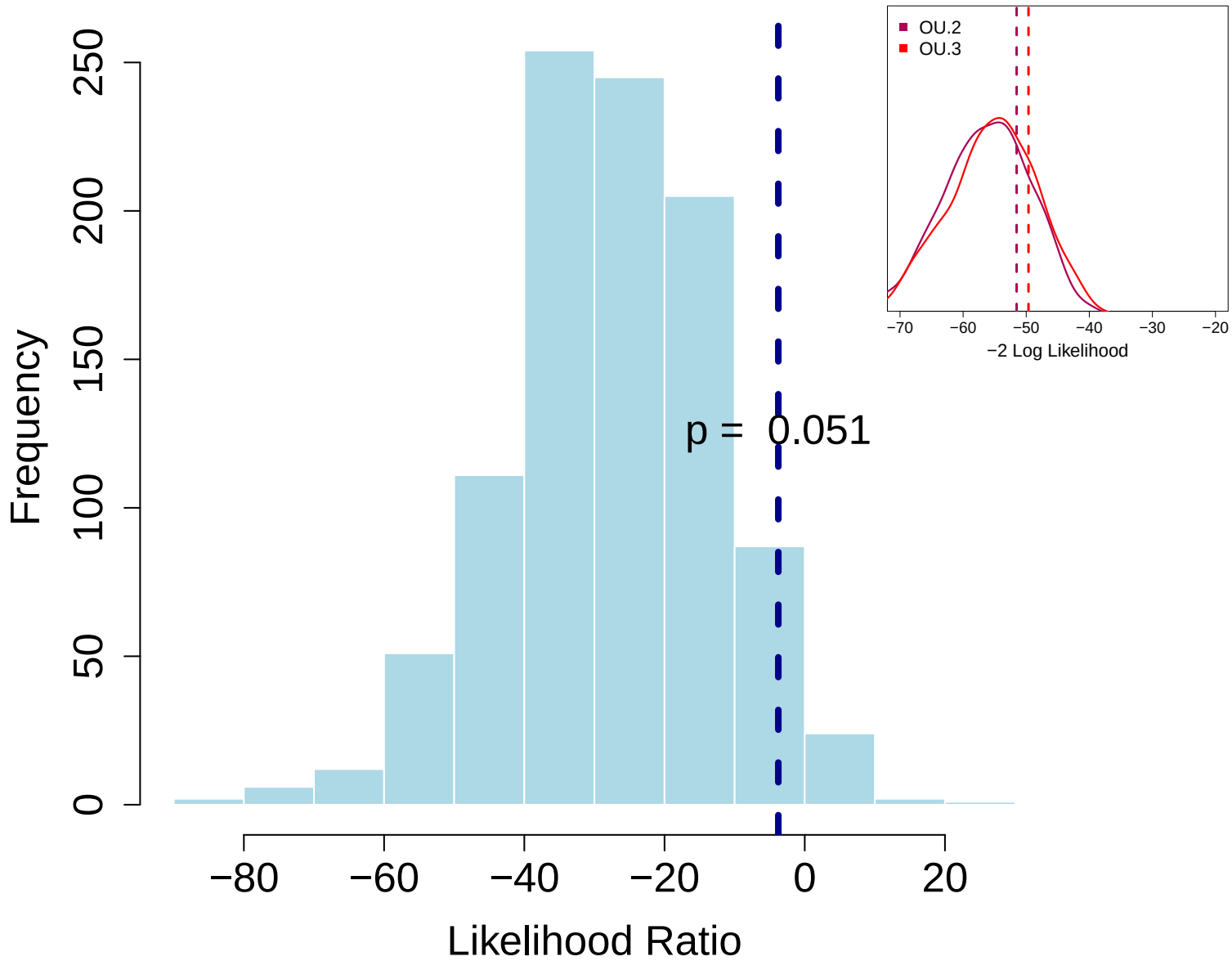


When data is insufficient to distinguish,
method can say *"I don't know"*

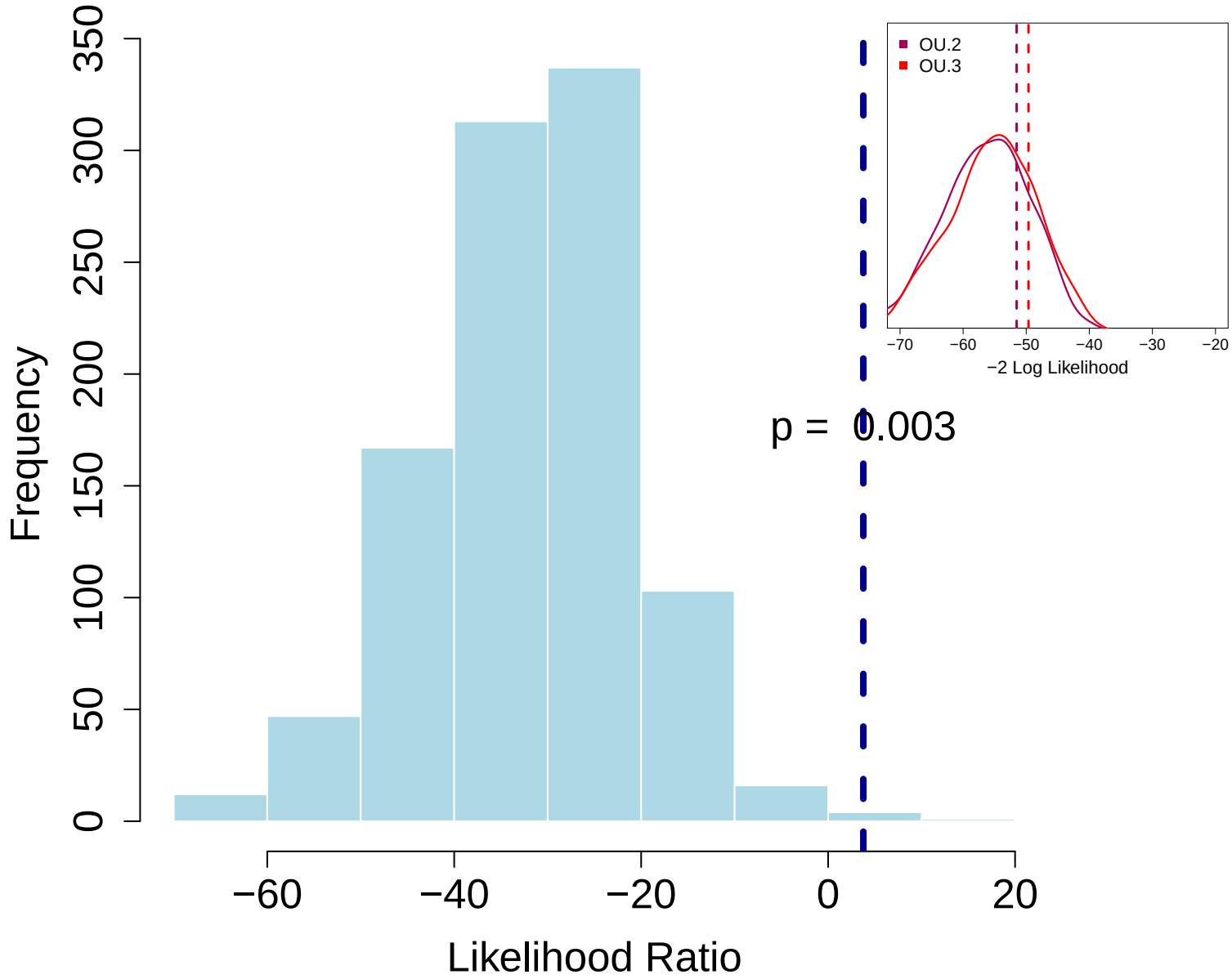
Can we distinguish between OU.2 and OU.3?



Simulate under OU.2 and compare to OU.3 . . .

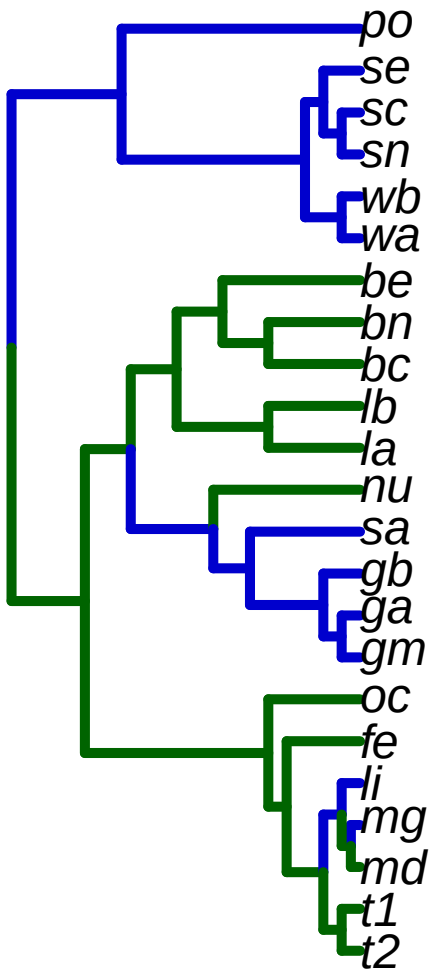


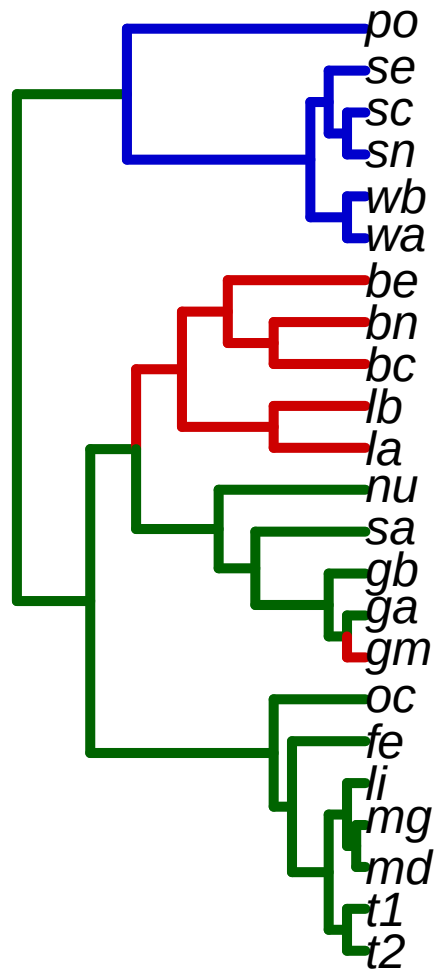
OU.3 vs OU.2: Now we're preferring OU.2!



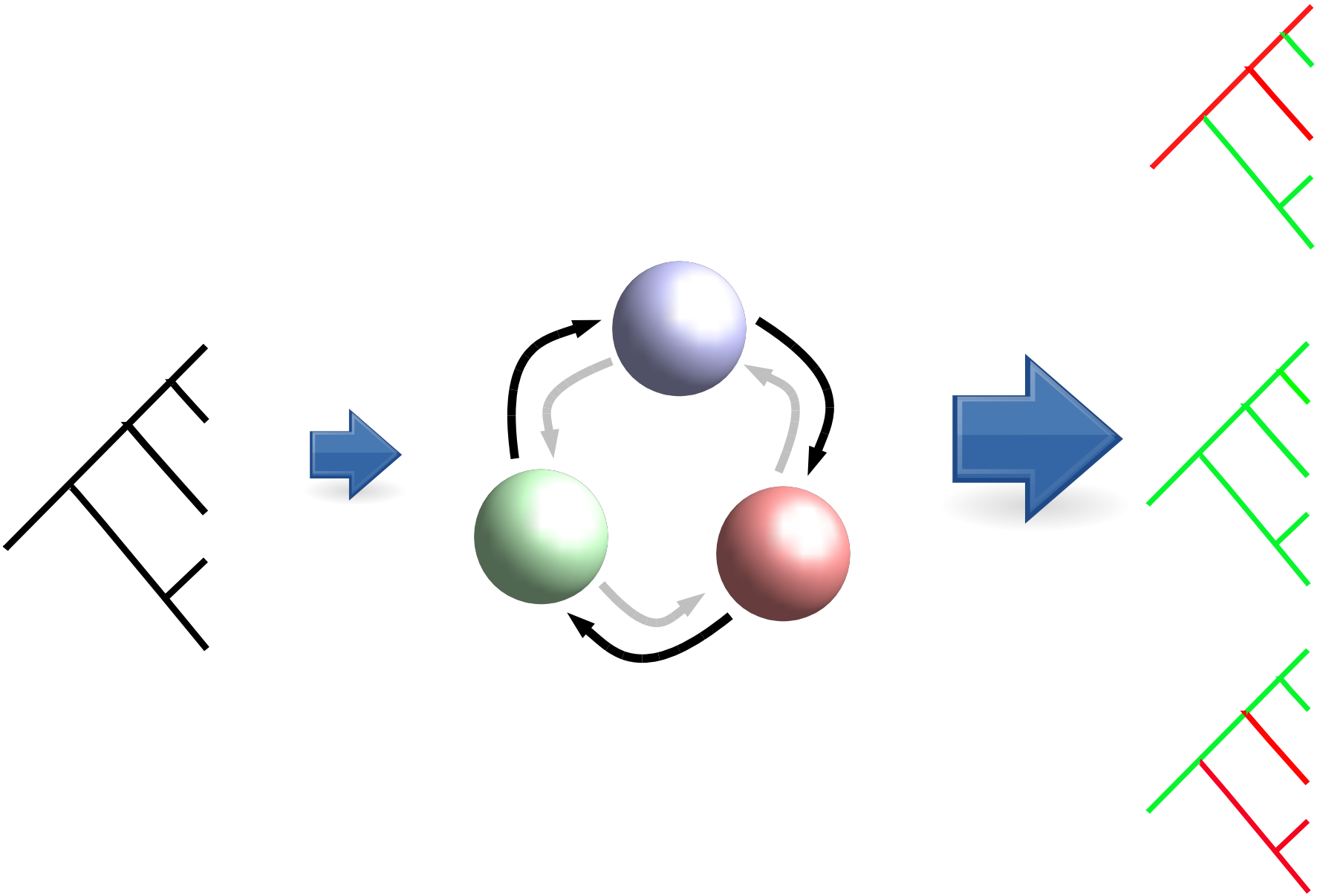
Model A rejects Model B.
Model B rejects Model A.

Non-nested models



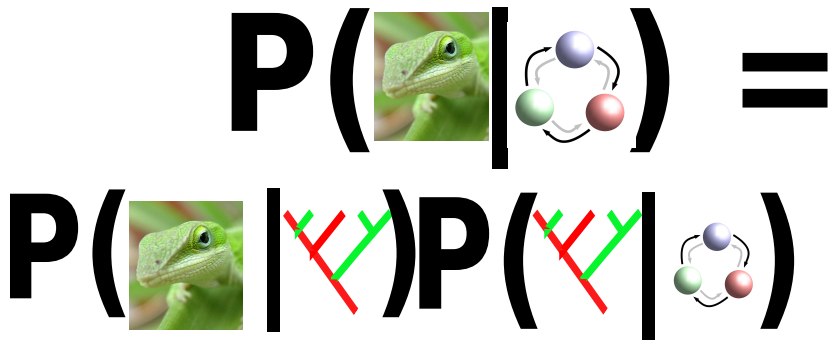


Replacing paintings with a transition model



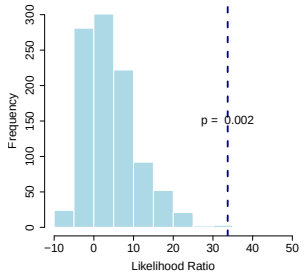
- All models are nested
- Estimate *number* of niches
- Also estimate *rates* of transitions

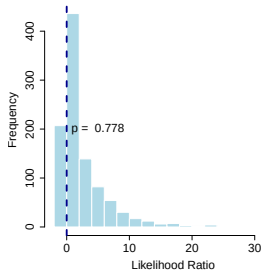
A hard problem in two easy pieces

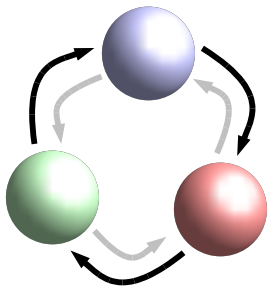


Summary

1. Quantifiable, robust model choice
2. Identify when data is insufficient
3. New framework avoids painting & non-nested comparison

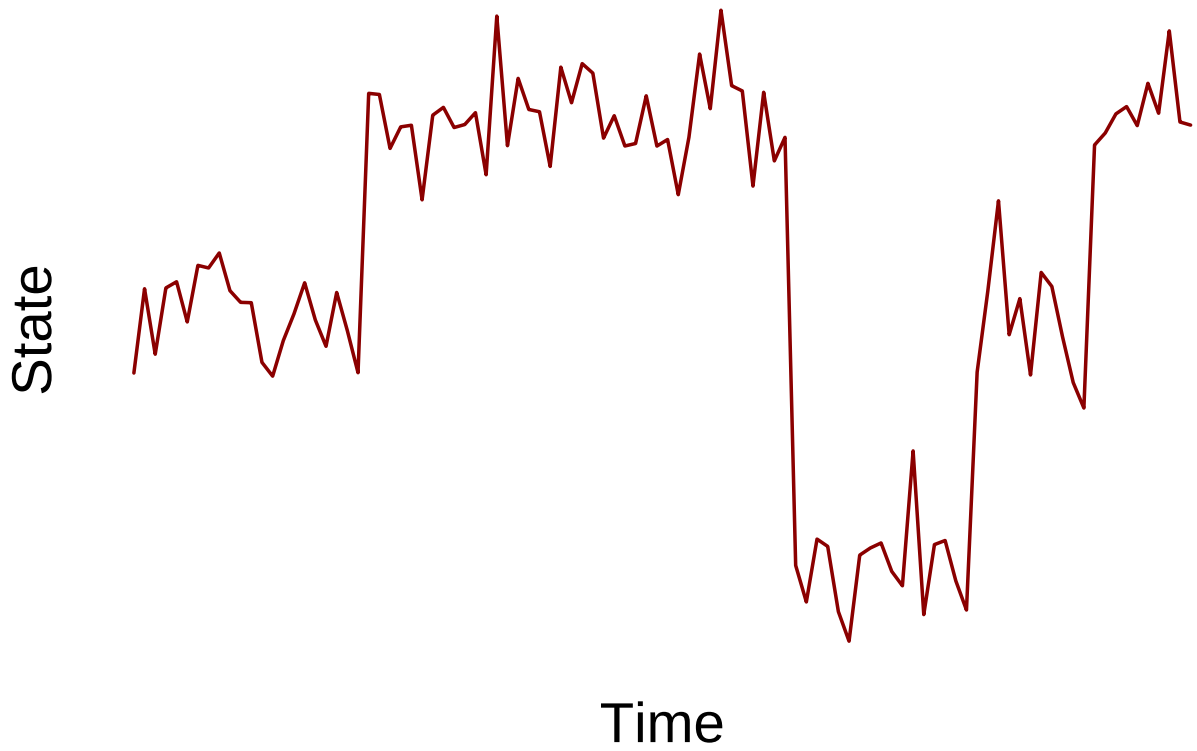


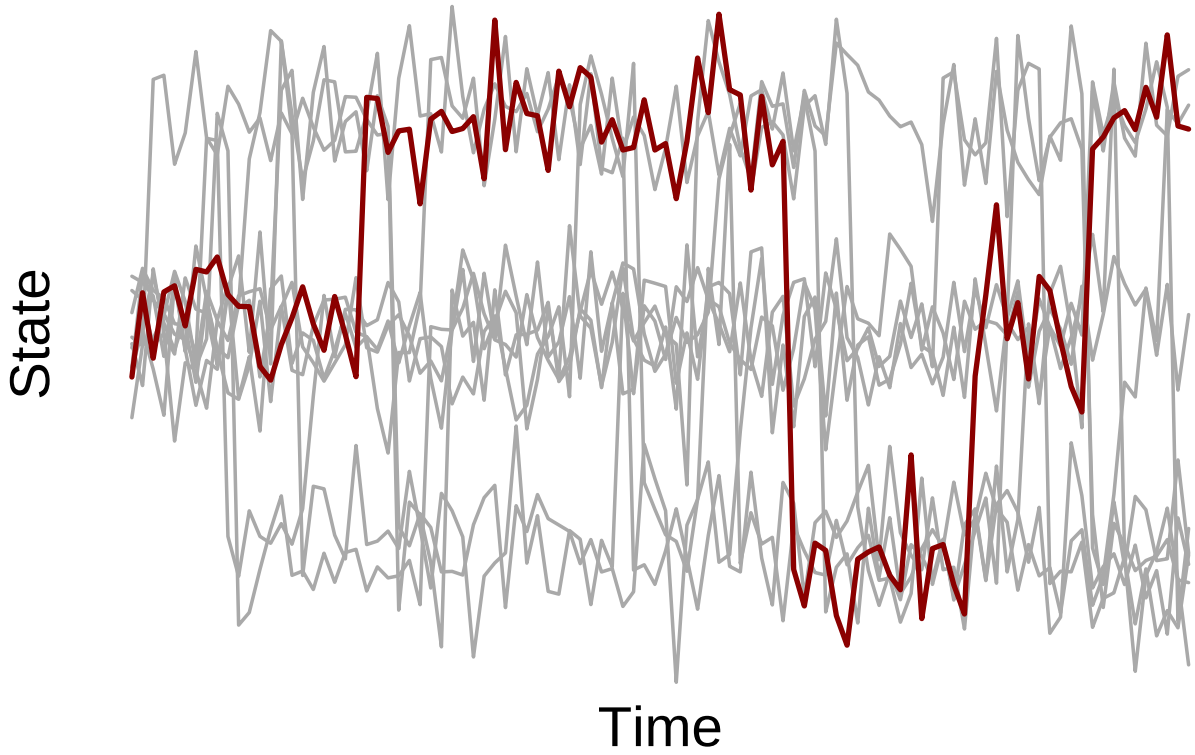


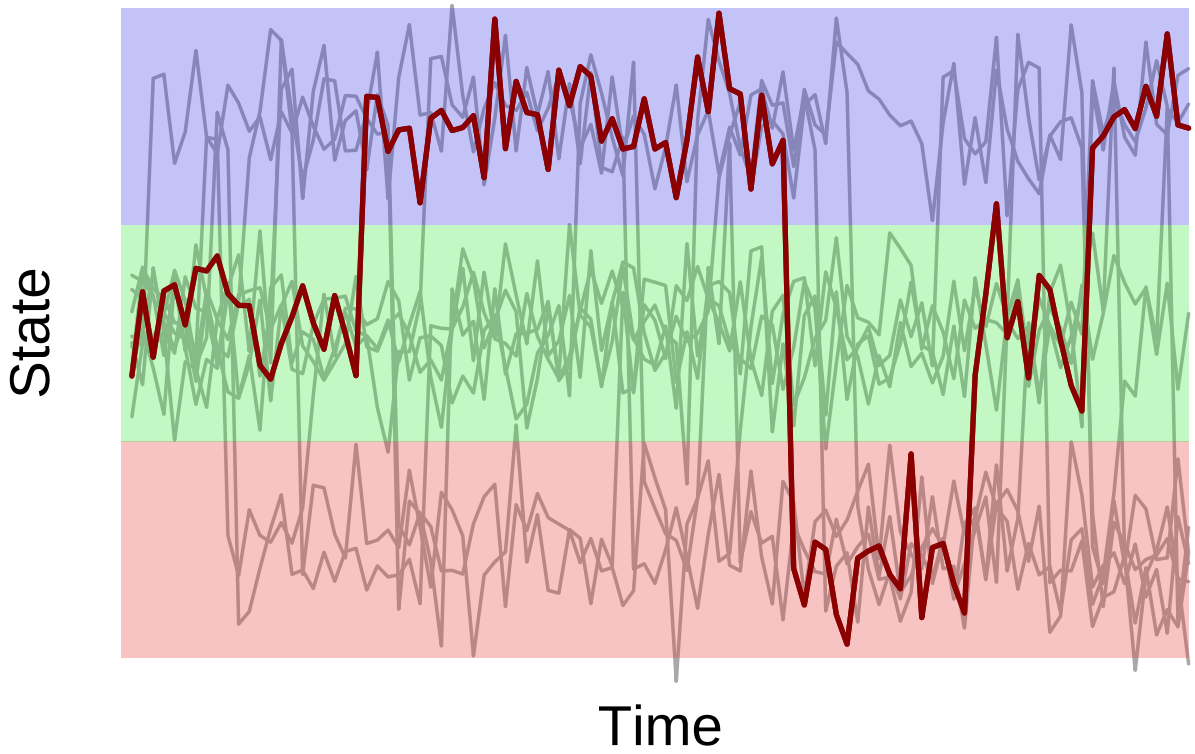


Thanks!

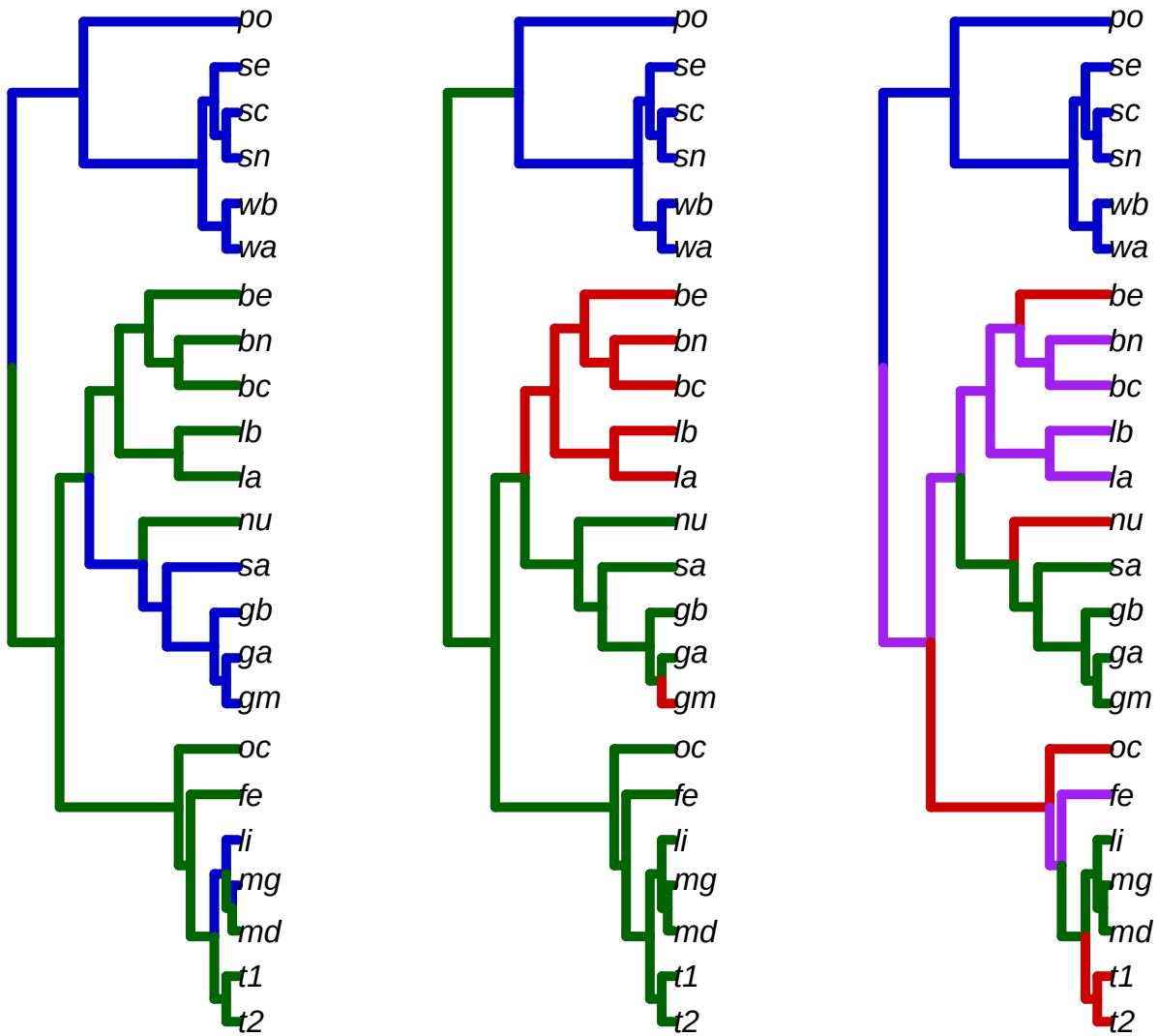
- Chris Martin
- Peter Wainwright
- Samantha Price
- Roi Holzman
- Graham Coop
- Peter Ralph
- Alan Hastings
- DoE CSGF







Comparing Models



OU.3 vs OU.4: Why you should mistrust painting trees