Gambling with Australian brachiopods

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Gambler's Ruin

Definition

Given infinite time, all gambler's go bust.

Death of a taxon

Taxa as gamblers

All taxa, given infinite time, go extinct.

Foundation

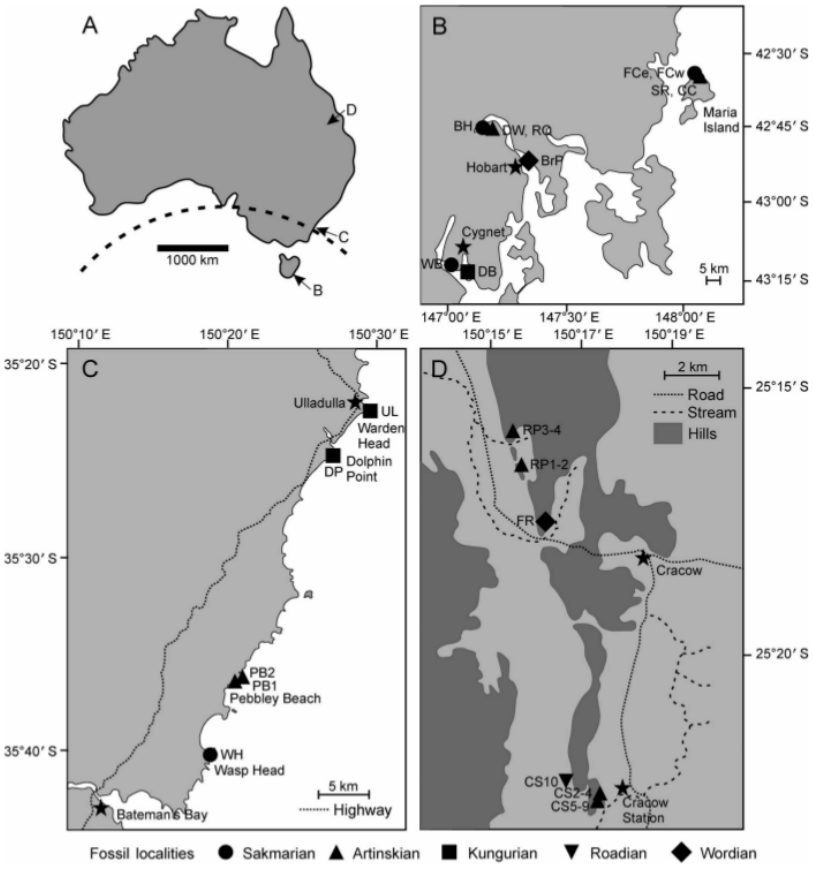
Question

Why do taxa go extinct at different rates?

Enter brachiopods

(Immersion Imagery, Shutterstock; Wikimedia)

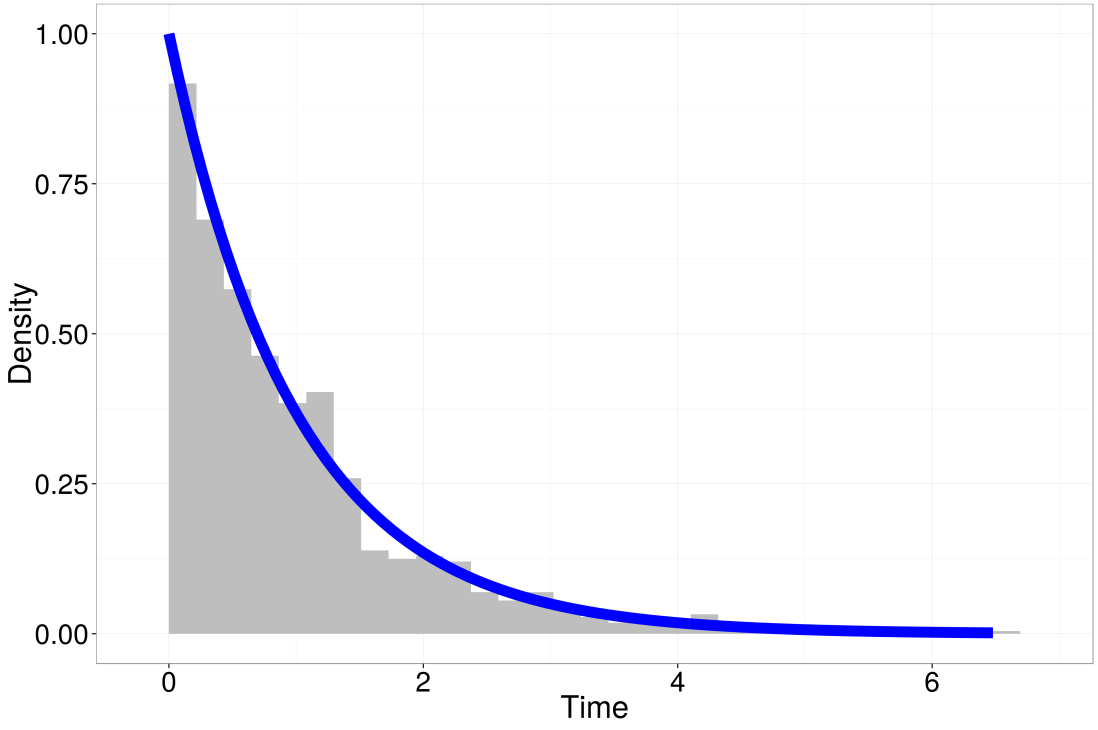
System details

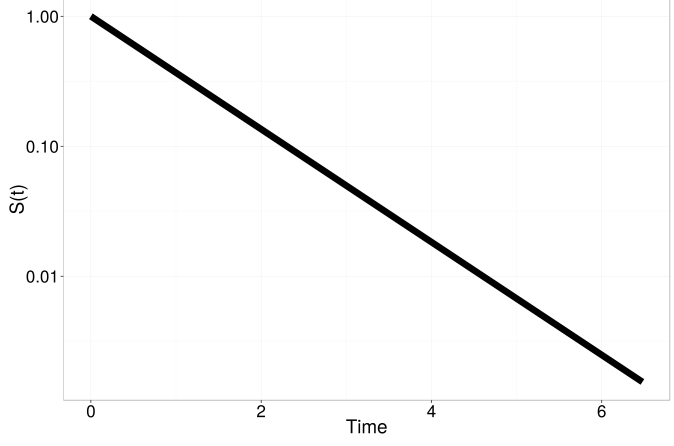


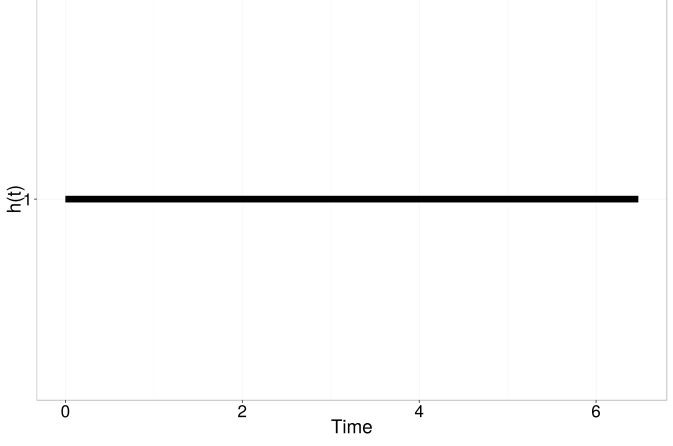
(Clapham and James 2008 *Palaios*)

- Australian Permian
  - range in/out taxa right censored
- predictors
  - substrate probability (fully Bayesian approach)
  - onshore/offshore
  - body size (Payne *et al.* 2014 *Proc. B*)
  - occupancy (see Vilhena *et al.* 2014 *Nature Com.*)

Survival analysis







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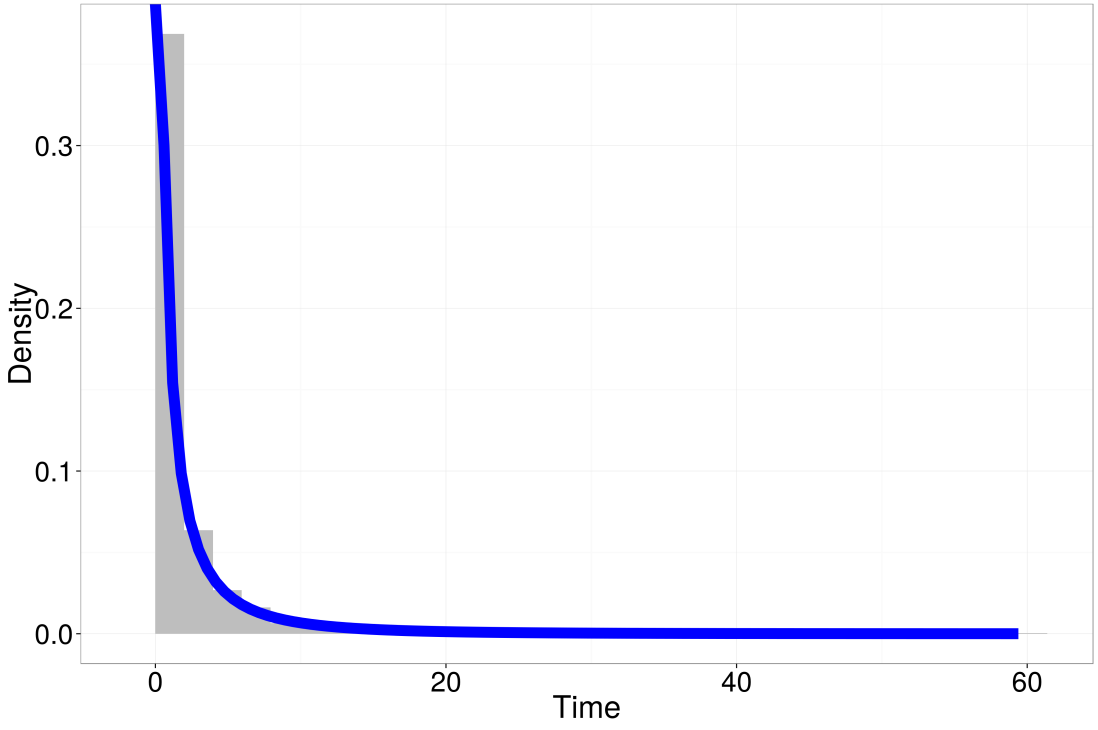

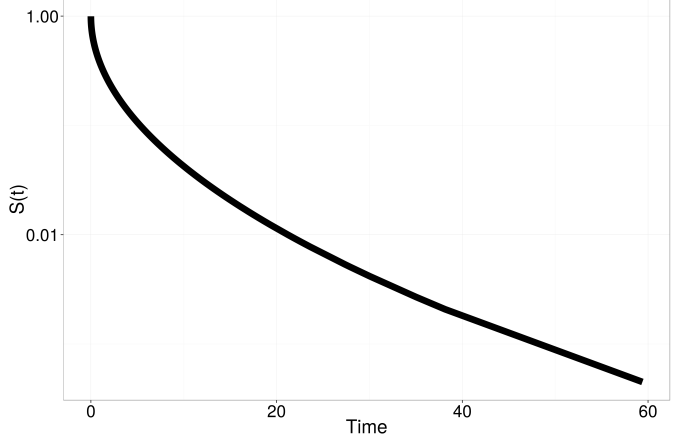

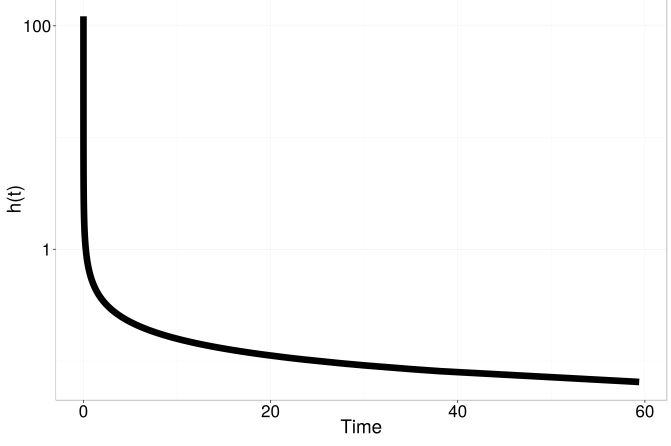

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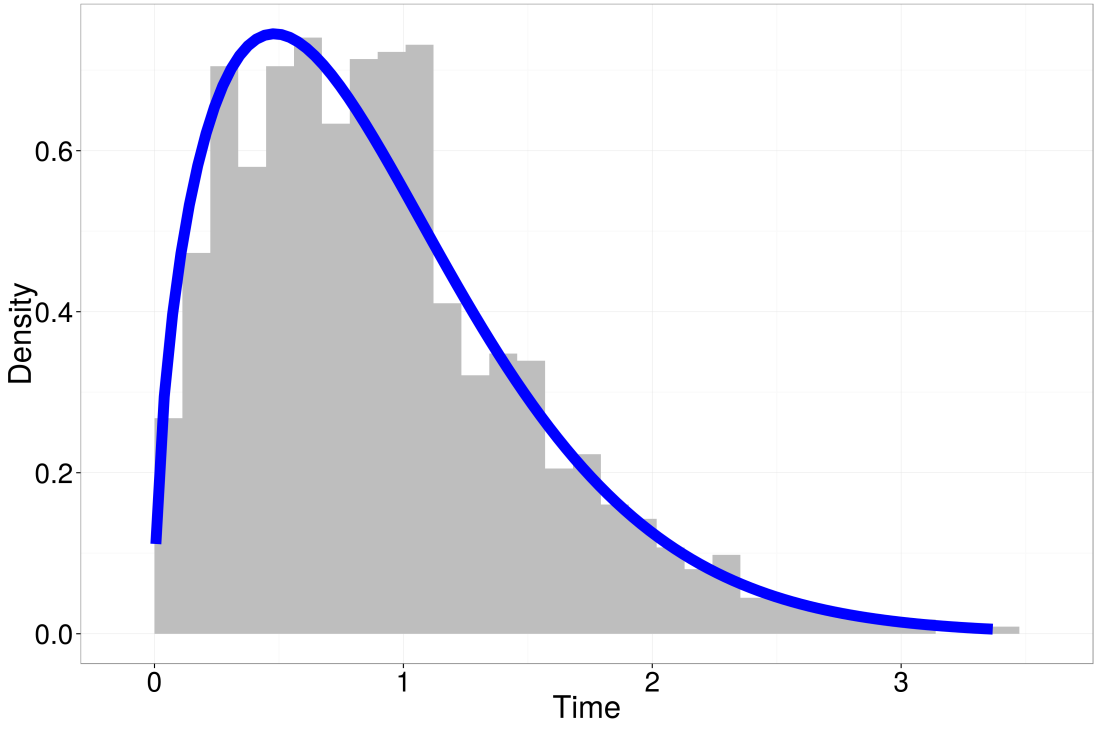
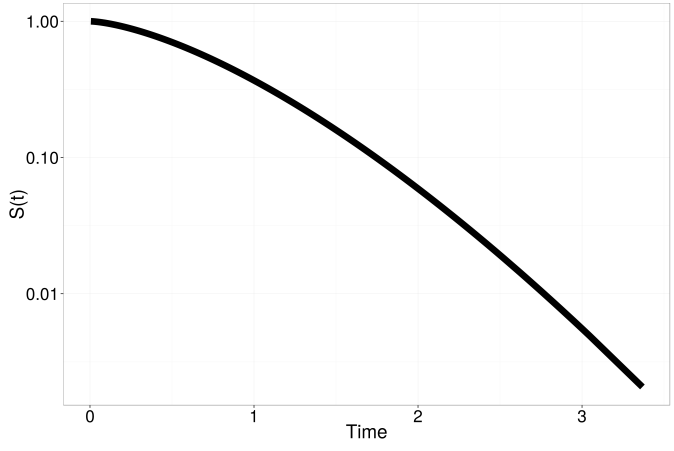
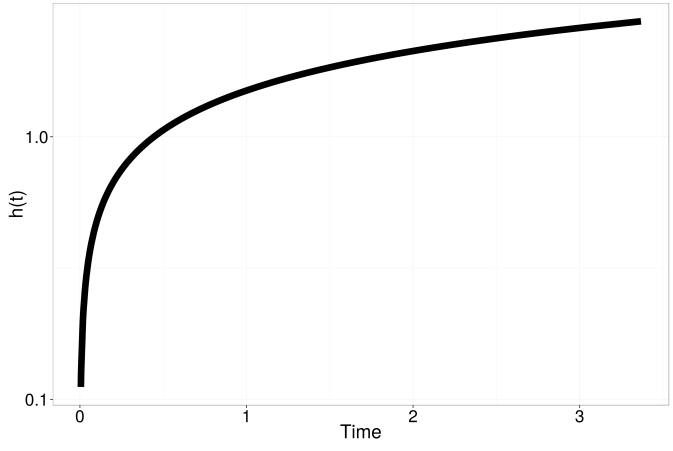
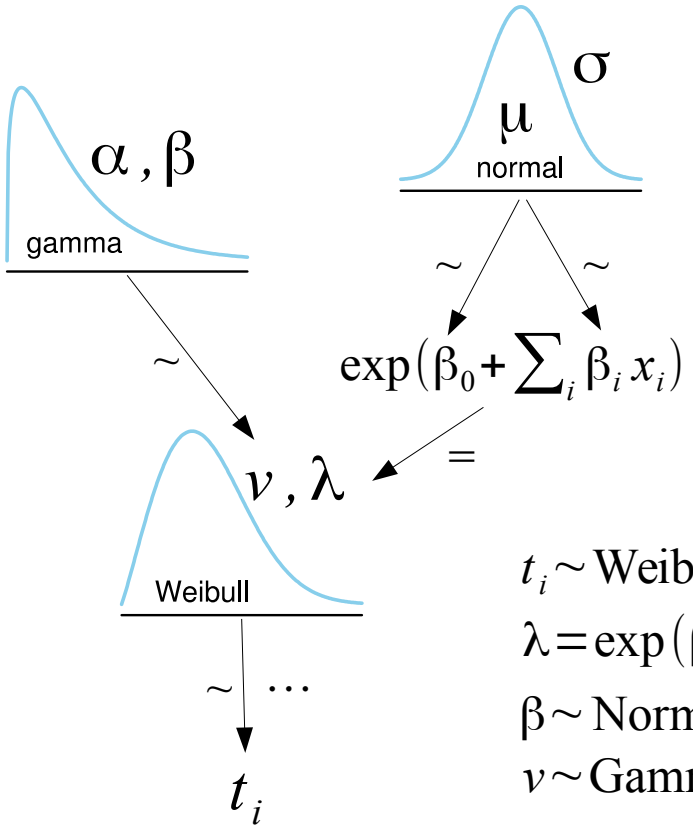




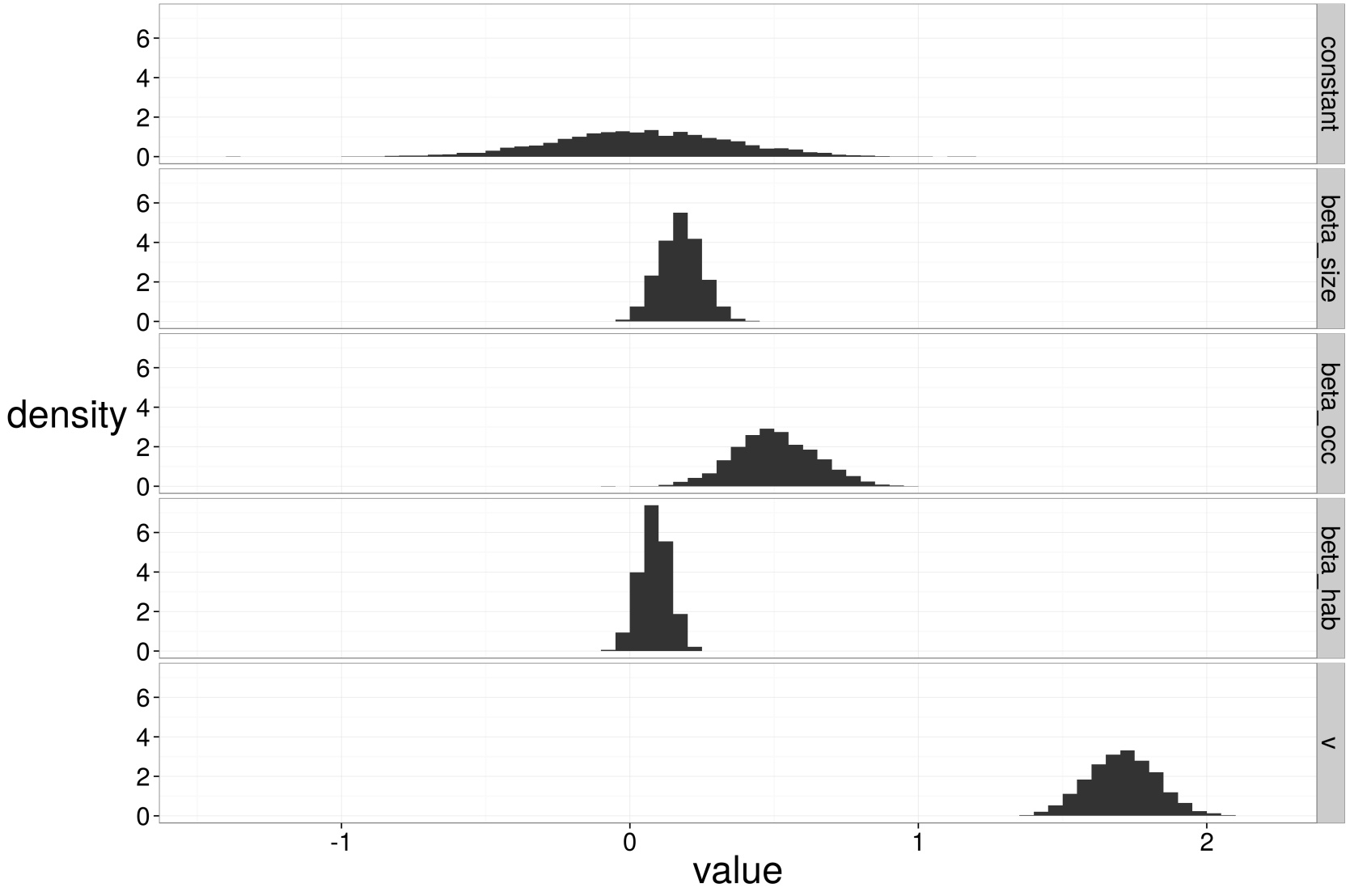


Bayesian model structure

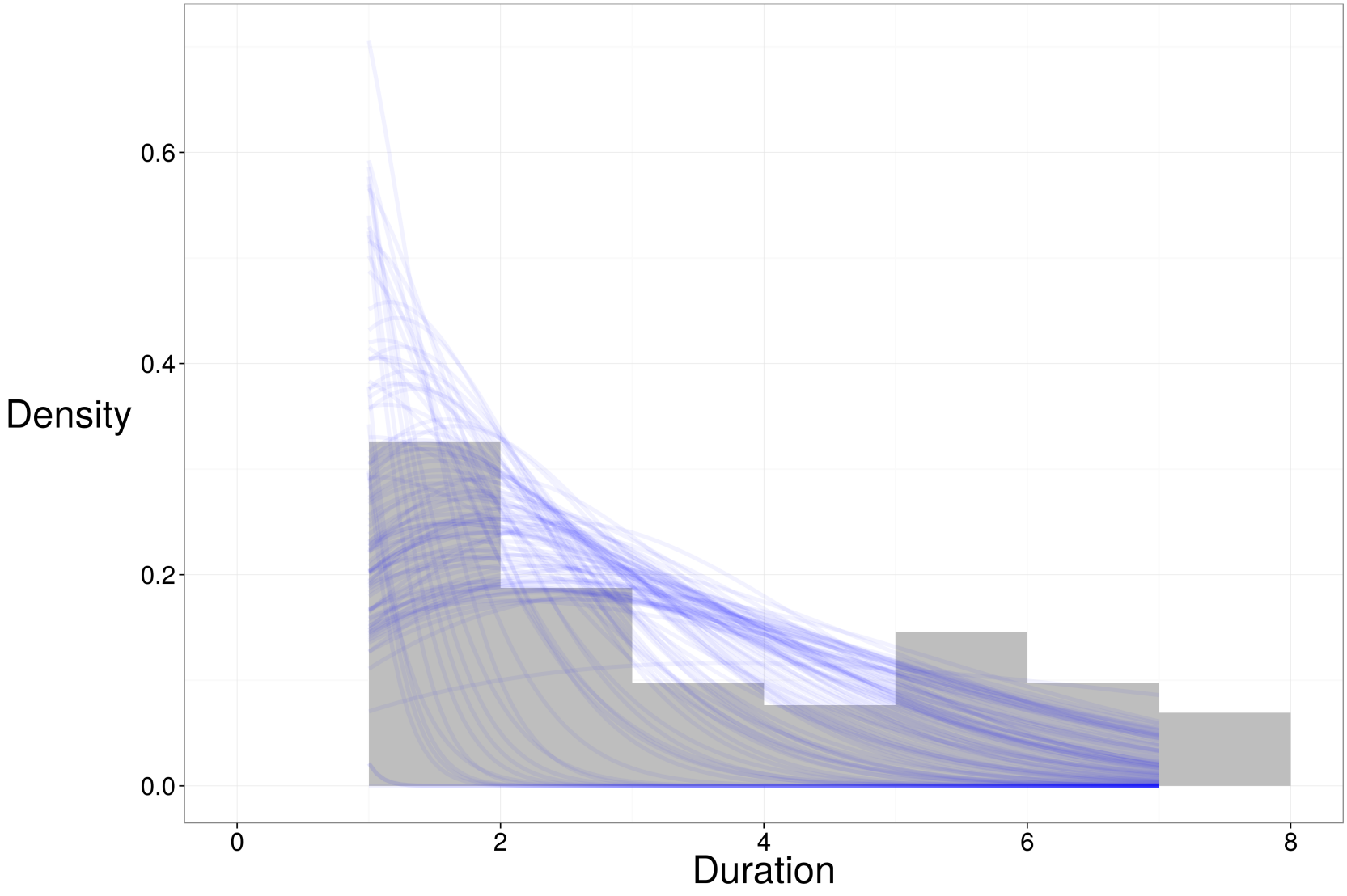


$$t_i \sim \text{Weibull}(\nu, \lambda)$$
$$\lambda = \exp(\beta_0 + \sum_i \beta_i x_i)$$
$$\beta \sim \text{Normal}(\mu, \sigma)$$
$$\nu \sim \text{Gamma}(\alpha, \beta)$$

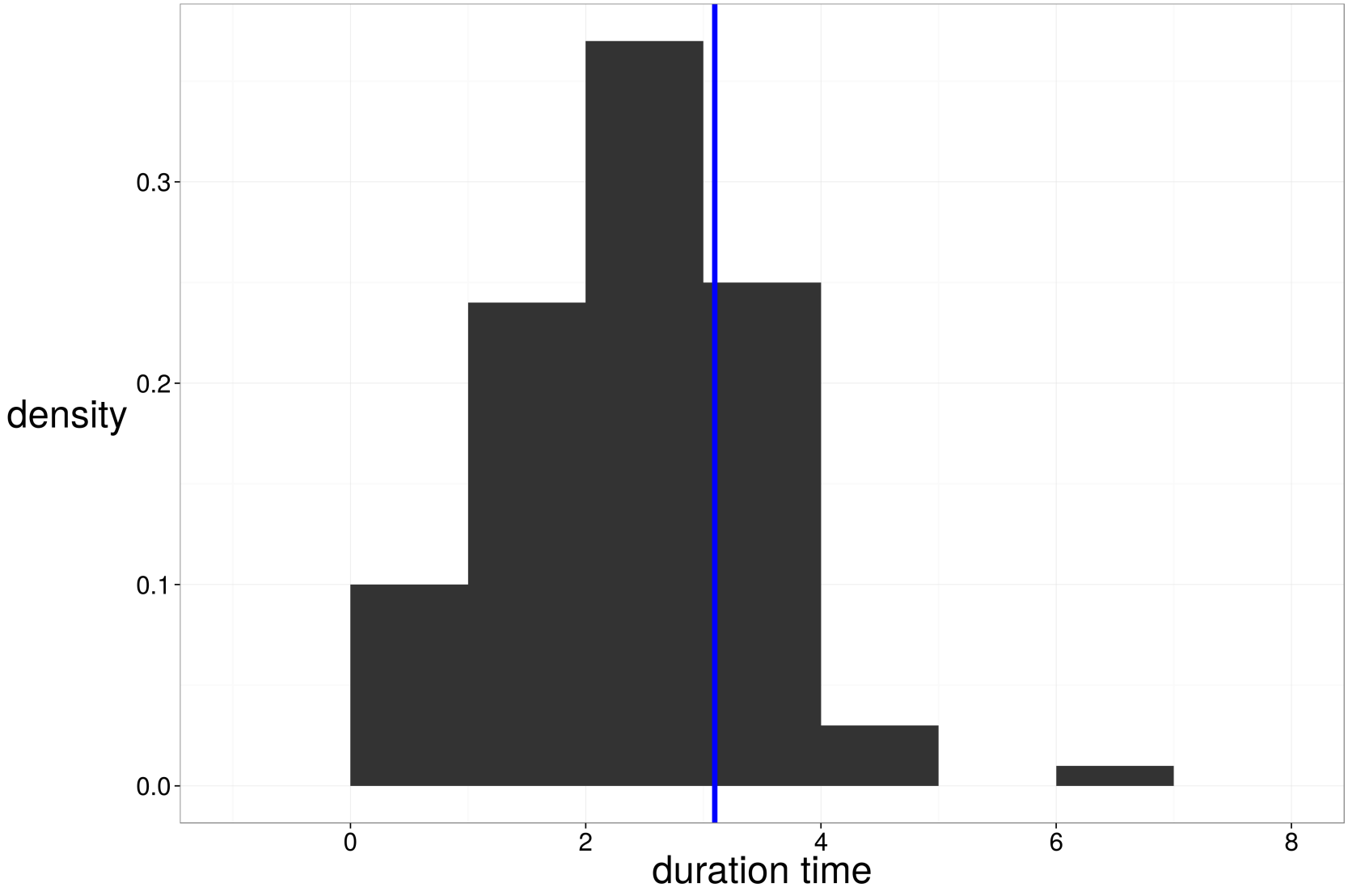
Parameter marginal posteriors



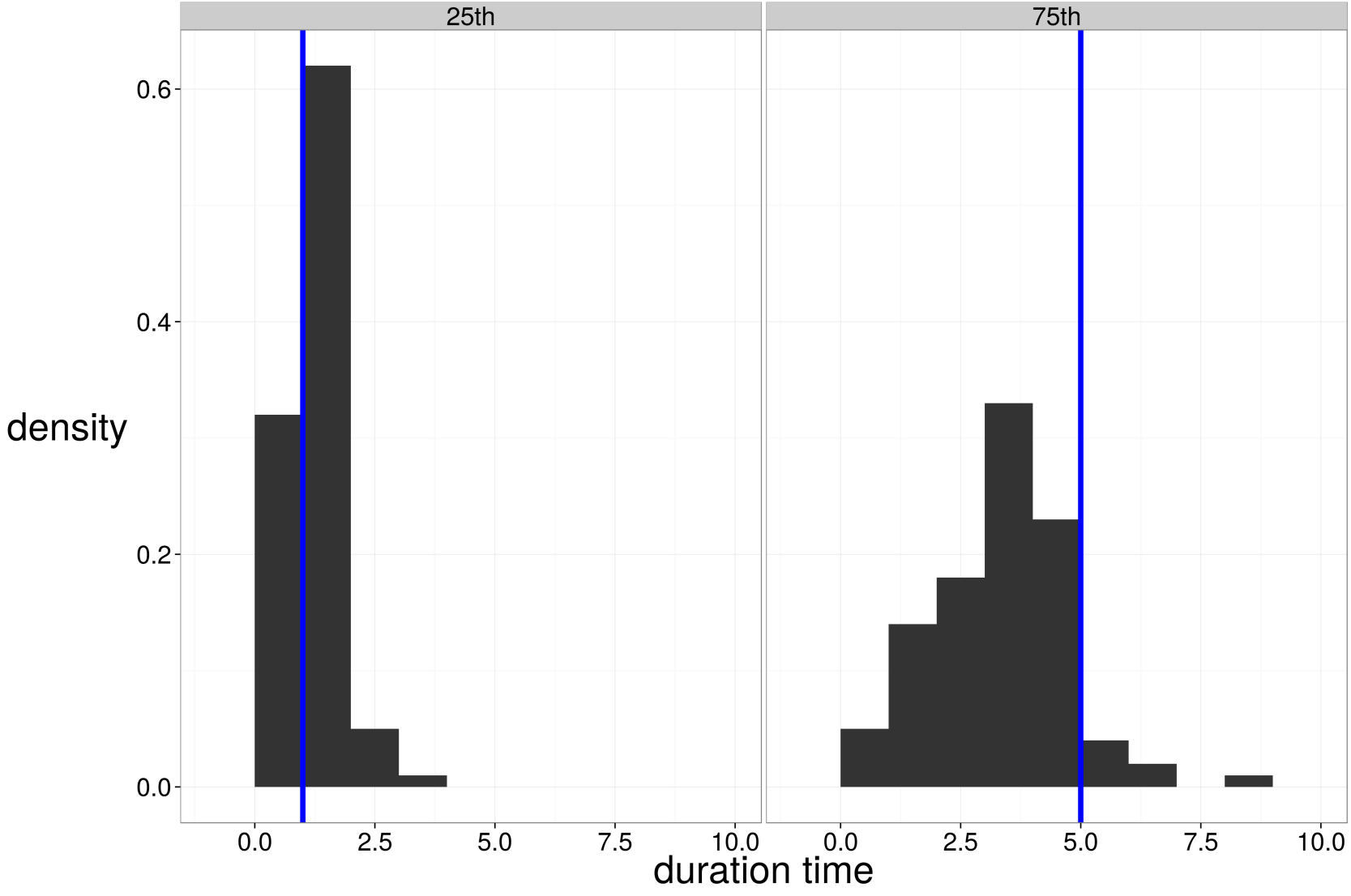
Durations



Posterior predictive check: mean duration



Posterior predictive check: quantiles



State of knowledge

Preliminary conclusions

Little evidence for single pattern of age-independence.

Occupancy has largest effect.

Modeling improvements

Major roadblock

HEAVY TAILS

- sampling distribution choice
- robust/different priors
- non-linear/heterogeneous variance
- fossil sampling effect

Data set

- New Zealand record (FRED)
- improved paleoenvironment reconstructions
- affixing strategy information

Remember. . .

Analysis is a narrative

- fit model
- evaluate model
- improve model/include more information

Acknowledgements

- Advising
  - Kenneth D. Angielczyk, Michael J. Foote, P. David Polly, Richard H. Ree
- Discussion
  - David Bapst, Megan Boatright, Ben Frable, Marites Villarosa Garcia, Kathleen Ritterbush, Darcy Ross, Liz Sander, Carl Simpson

The Field Museum

Fossilworks

The Paleobiology Database
revealing the history of life