AIC and all that

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Background

- novel approach to *model selection*
- $\underbrace{-2L}_{\text{badness of fit}} + \underbrace{2k}_{\text{complexity penalty}}$
- minimize expected difference
- asymptotically equivalent to *leave-one-out cross-validation*2
- typical method: fit all (?) possible models ("dredge")
- select best model (?)
- compute *AIC weights*
- multi-model averaging

Problem

McGill (2015), "Why AIC Appeals to Ecologist's Lowest Instincts": some goals of statistical ecological modeling are

> . . . estimation of parameters, testing of hypotheses, exploration of covariation, prediction into new conditions, selecting among choices (e.g. models) . . .
>
> (*could add "quantifying variable importance"*);
>
> With AIC you present that classic table of ΔAIC and weights and voila! You've sort of implied doing all five statistical goals at once.

Advantages

- simple
- handles non-nested models (but see Ripley (2004))
- accounts for model complexity

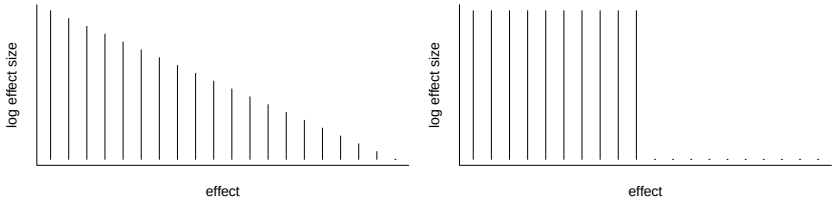
AIC goals

- AIC is for *prediction*
- is it OK to use it to test hypotheses?

ICs

- distinction among ICs
  - AIC

  - DIC: (Spiegelhalter et al. 2002): prediction for Bayesian multilevel models
  - BIC: identify true model (Yang 2005)
  - AICc: finite-sample correction (Richards 2005; Fletcher and Dillingham 2011)
  - QAIC: correct for overdispersion
  - CAIC (conditional) (also DIC): multilevel predictions (Vaida and Blanchard 2005; O'Hara 2007)
- statistical inconsistency/overfitting argument; consistency vs efficiency (Yang 2005) and *tapering effect sizes*: blog post



- still need to respect limits of model complexity (Harrell 2001)
- model-averaged CIs are a good idea, but still represent hypothesis testing

Model selection

- OK, but why?
- don't take $\Delta\text{AIC} > 2$ criterion too seriously

Multimodel averaging

- averaging *predictions* is completely OK
- parameter averaging (Cade 2015)
  - must average *predictions*
  - parameters in linear models *may* represent predictions
  - problems with multicollinearity; interaction terms (Schielzeth 2010); nonlinear models
  - how to average zero values?
- `MuMIn`, `AICcmodavg` packages
- multimodel averaging shrinkage vs. penalized regression (Lasso/elastic net/et al.)

Weights and variable importance

- are model weights probabilities? of what?

- prob. of inclusion in true best model?
- 'savvy priors'
- what would Bayesian probabilities mean?

Alternatives

- penalized regression not without challenge either, but much faster
- expanded models (with shrinkage?), i.e. don't test point hypotheses

Good practice

- consider adequacy
- present ΔAIC, not AIC (`bbmle::AICtab`)
- graphical results: don't just present AIC table
- don't take discrete hypotheses too seriously
- be careful

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