

AIC and all that

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23:41 05 July 2015

Background

- novel approach to *model selection*
- $\underbrace{-2L}_{\text{badness of fit}} + 2k_{\text{complexity penalty}}$
- minimize expected difference
- 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

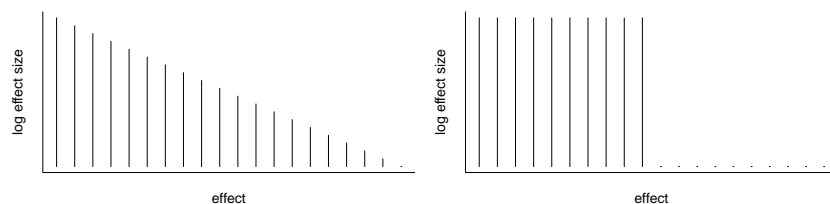
- simple
- non-nested (although cf. Ripley (2004))
- accounts for model complexity

AIC goals

- AIC is for *prediction*

ICs

- distinction among ICs
 - AIC, DIC (Spiegelhalter et al. 2002): prediction
 - BIC: identify true model (Yang 2005)
 - AICc: finite-sample correction (Richards 2005; Fletcher and Dillingham 2011)
 - QAIC: correct for overdispersion (important!)
 - CAIC (conditional), DIC: predictions at different hierarchical levels (O'Hara 2007)
- statistical inconsistency/overfitting argument; consistency vs efficiency (Yang 2005) and *tapering effect sizes*: blog post



- asymptotically equivalent to leave-one-out cross-validation
- 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 $\Delta AIC > 2$ 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

- 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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