State space model selection and the many faces of DIC

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Abstract: The Deviance Information Criterion (DIC; Spiegelhalter et al. 2002) is a popular means among ecologists for comparing the fits of Bayesian hierarchical models to data. Several studies have, however, raised concerns about the reliability of DIC in selecting an adequate model (e.g. Celeux et al. 2006). These concerns are closely related to the ambiguity in defining DIC: depending on which variables in a hierarchical model are considered parameters, and thereby what part of the model is viewed as constituting the likelihood and what part is considered the prior, different DICs are obtained. These DICs at different 'levels of focus' can behave very differently and if an inappropriate focus is chosen, model selection by DIC may even become nonsensical (Millar 2009). There are currently few, and conflicting, guidelines for which focus to choose in any particular situation and it appears likely that different types of models may require different guidelines. We investigate the role the choice of focus of DIC plays in selection among state space models of population processes. A simulation study is designed where a set of models that differ both in the observation process and in the underlying population process, are fit to simulated data. DICs and complexity penalties at several levels of focus are evaluated for the models and simulated data to see how they perform and compare in picking up model differences.

References

Celeux, G., Frobes, F., Robert, C.P., and Titterington, D.B. (2006). Deviance Information Criteria for missing data models. *Bayesian Analysis*, 1:651–674.

Millar, R. B. (2009). Comparison of hierarchical Bayesian models for overdispersed count data using DIC and Bayes' factors. *Biometrics*, 65:962–969.

Spiegelhalter, D.J., Best, N.G, Carlin, B.P., and van der Linde, A. (2002). Bayesian measures of model complexity and fit. *Journal of the Royal Statistical Society B*, 64:583–639.