Integrated Environmental Assessment and Management — Volume 8, Number 1—pp. 4


Letter to the Editor

# Response to Landis and Chapman (2011)

*David R Fox*†,‡*

†*Environmetrics Australia and the University of Melbourne, Melbourne, Australia*
‡*P.O. Box 607, Templestowe, Victoria 3106, Australia*

*(Submitted 22 September 2011; Accepted 21 October 2011)*

Congratulations to the authors for their concise summary of the flaws, frailties, and limitations of ANOVA-based toxicity metrics. Having made similar calls for a transition to model-based inference, I am naturally fully supportive of the Landis and Chapman ''fatwa'' on bankrupt statistical methods in ecotoxicology.

This timely article should, and no doubt will, generate much discussion among ecotoxicologists. We should expect pockets of resistance to emerge. Strident supporters of current practice will no doubt appeal to the long history of ''achievement'' that has accompanied the use of NOECs, NOELs, and LOELs, whereas xenophobia may generate some ''push-back'' and inertia to change.

Although there should be open discussion of the merits of various modeling and data analysis techniques, I hope we can move beyond some of the age-old debates such as the subjectiveness of choosing a prior distribution in a Bayesian analysis. Statisticians spent many years and countless journal pages to this and other modeling issues and although not diminishing the importance of those discussions, I do not believe the practice of ecotoxicology will be well-served by resurrecting them.

Another often-cited criticism of model-based approaches to the derivation of toxicity measures is the claimed arbitrariness of model selection. Although it is true that there is a plethora of candidate mathematical functions to represent a concentration-response (C-R) curve, since when did scientists find that problematic? Indeed, anyone who has carried out a bivariate regression of ''y on x'' will have been confronted with issues of nonlinearity, heteroscedasticity, nonnormal residuals, and lack-of-fit. We deal with these ''problems'' in a variety of ways—we either choose to ignore them or we do something about it by transforming the data and/or using a different functional form. The art of modeling and inference is parsimony—to achieve a good representation of the data at hand using a model that is both plausible and simple. Although the model-fitting process can be usefully guided by so-called goodness-of-fit statistics such as error-sums-of squares, deviance, and Akaike's Information Criterion, the bottom line is that the modeler drives the process and makes many and varied decisions as how to proceed. To paraphrase eminent statistician George Box, ''all models are wrong, it's just that some are useful.''

Landis and Chapman (2011) have been quite blunt: ''we call on the Editors-in-Chief of the 2 SETAC journals to ban statistical hypothesis tests for the reporting of exposure-response from their journals,'' and they were no doubt encouraged by the infamous case of a similar ban by the editor of the *American Journal of Epidemiology*. What was not acknowledged, however, was the ensuing uproar and a retreat from that position. In a recent article on the future of statisticians and statistical science, I noted that ''the philosophical debates about null hypothesis significance testing (NHST) have been with us for many years and the attempts of a single misguided journal editor to deny the existence of a well-established mode of statistical inference were inevitably doomed from the beginning'' (Fox 2010). So although I agree wholeheartedly with the present call to elevate the statistical rigor in ecotoxicology, I find myself in disagreement with calls for outright ban on some modes of statistical analysis. I do not believe forcing one particular mode of thinking over another is the way to proceed. The critical issue as I see it is one of education rather than regulation.

## REFERENCES

Fox DR. 2010. Desired and feared—Quo vadis or quid agis? 2010. *Am Stat* 64:6–8.

Landis WL, Chapman PM. 2011. Well past time to stop using NOELs and LOELs. *Integr Environ Assess Manag* 7:vi–viii.

* To whom correspondence may be addressed: david.fox@environmetrics.net.au
Published online in Wiley Online Library (wileyonlinelibrary.com).
DOI: 10.1002/ieam.1264