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Scientific parameterization and its validation: comparing the universal models of fisheries economics with the invalid modeling of stock assessment

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Abstract

Here I compare the valid parameterization of fisheries economics with the data-fitted parameters of a stock assessment's modeling, invalid models whose predictions cannot be falsified (which is another way of saying the models are not universal). The distinction between (a) a model's valid universal prediction and (b) a model's invalid prediction that cannot be falsified can be summarized in terms of a model's parameterization, as:

high falsifiability = paucity of parameters = simplicity

The universal laws of physics, for example, are simple: they have few parameters and a high degree of falsifiability. It is this high degree of falsifiability or negation that guides all engineers by showing them what cannot be achieved and should not therefore be tried as part of 'trial and error' engineering. By contrast, the models of fish stock assessment are not simple: their data-based parameters change with the changing data. These models are not universal; they apply only to a particular fishery situation and are incapable of guiding all fishery managers (all social engineers) by indicating what cannot be achieved in a social engineering. Under Karl Popper's limited (and formal) definition of empirical science data-fitted models proffer policy advice to fisheries management that is formally invalid.

Keywords: parameterization, validation, universal laws, economics

Introduction

In a recent chapter on Antarctic whaling in *Management of Shared Fish Stocks* Sidney Holt (2007, pp. 131-150) kindly draws attention to the distinction I make between (a) the universal models of fisheries economics (as in Fig. 1A); models that can be falsified, and (b) the models of fish stock assessment (as in Fig. 1B); models that cannot be falsified (which is another way of saying the models are not universal) (Corkett, 2002). This distinction can be summarized in terms of propositions. Propositions are of primary interest to the logician since they can be classified as *true* or *false* or, in the case of Popper's falsifiability theory, as a '*There-is' proposition* or a '*There-is not' proposition*.

Models of fisheries economics, universal models whose predictions can be falsified

The laws of science make predictions that can be falsified, that is the predictions are universal. It is the falsifiability of these predictions that guide the engineer (fisheries manager) by indicating what *not* to do! The economic *law of diminishing returns* as applied to Gordon's version of the Schaefer model (Corkett, 2002, my Fig. 1(a)) can be used to illustrate a falsifiable MSY prediction (Fig. 1A). This prediction can be put in the form of a *'there-is-not' proposition* (Popper, 1959, p. 69), as:

There is no situation in which the greater the diminishing returns to effort the shorter it will take to reach the MSY and the shorter it will take to decline afterwards {1}

Why {1} is falsifiable can be illustrated with reference to a simple inference involving two contradictory propositions, propositions that cannot both be true, as:

(i) *There are no* black swans (*'there-is-not' proposition*)
(ii) Here is a black swan {2}

If we take (ii) as representing the empirical evidence as a test proposition and if, for the sake of argument, we accept (ii) as true, then we are committed to conceding (i) is false. As with any valid inference, the acceptance of (ii) as true does not guarantee (i) is false, it only guarantees that *if* (ii) were true then (i) would be false. Of course we may have made a mistake in accepting the test proposition as true, but in no way whatever does this mistake detract from the validity of the inference.

Models of stock assessment; invalid models whose predictions cannot be falsified

I used Ricker's version of a Gordon Schaefer model (Corkett, 2002, my Fig. (c)) to illustrate a non falsifiable MSY prediction of stock assessment, a prediction that, like that in Fig. 1B, takes the logical form of a *'there-is' proposition* (Popper, 1959, p. 68), as:

There is a MSY of 30 million pounds {3}

Why {3} cannot be falsified may be illustrated in a simple way. Say, for the sake of argument, the next 10 years of data were to produce calculated yields in excess of 50 million pounds: this would substantially increase the estimated value for the MSY. However, this new value for the MSY could never falsify the old value for the MSY since it is always possible to visualize a situation where the next 10 years of very small calculated yields could return the MSY to the original value of 30 million pounds.

Falsifiability and validity explained in terms of parameterization

The difference between a valid prediction that possesses falsifiability (as in {1} and Fig. 1A) and an invalid prediction that has no falsifiability (as in {3} and Fig. 1B) can be summarized in terms of the paucity of a model's parameters (Popper, 1959, p. 142), as:

high falsifiability = paucity of parameters = simplicity

The universal laws of physics are simple: they have few parameters and a high degree of falsifiability. It is this high degree of falsifiability or negation that guides *all* engineers by showing them what *cannot* be achieved by a 'trial and error' engineering. By contrast the models of stock assessment are not simple; their data-based parameters change with the changing data. These models apply to a particular fishery situation; that is they are not universal and are incapable of guiding *all* fishery managers by showing them what *cannot* be achieved by 'trial and error' social engineering (Corkett, 1997). The data-fitted models of stock assessment provide policy advice that does *not* tell the manager 'what *not* to do' (as in a scientific law, see {1}, {2} and Fig. 1A) but tells the manager 'what to do' (as in political advice, see {3} and Fig. 1B). This positive 'political' advice is not valid universal advice, it takes the logical form of 'primitive magic' (Corkett, 2000) and can bear no fruit.

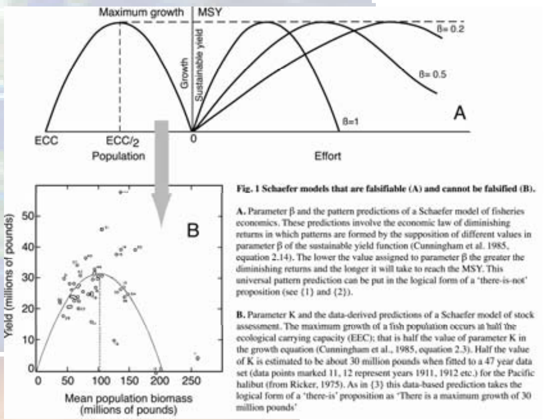

Fig. 1 Schaefer models that are falsifiable (A) and cannot be falsified (B).

A. Parameter β and the pattern predictions of a Schaefer model of fisheries economics. These predictions involve the economic law of diminishing returns in which patterns are formed by the supposition of different values in parameter β of the sustainable yield function (Cunningham et al. 1985, equation 2.14). The lower the value assigned to parameter β the greater the diminishing returns and the longer it will take to reach the MSY. This universal pattern prediction can be put in the logical form of a 'there-is-not' proposition (see {1} and {2}).

B. Parameter K and the data-derived predictions of a Schaefer model of stock assessment. The maximum growth of a fish population occurs at half the ecological carrying capacity (EEC); that is half the value of parameter K in the growth equation (Cunningham et al., 1985, equation 2.3). Half the value of K is estimated to be about 30 million pounds when fitted to a 47 year data set (data points marked 11, 12 represent years 1911, 1912 etc.) for the Pacific halibut (from Ricker, 1975). As in {3} this data-based prediction takes the logical form of a 'there-is' proposition as 'There is a maximum growth of 30 million pounds'

References

Corkett, C. J., 1997. Managing the fisheries by social engineering: a re-evaluation of the methods of stock assessment. Journal of Applied Ichthyology 13, 159-17.

Corkett, C. J., 2000. Fish Stock Assessment: an Inductive Science with the Logical From of 'Primitive Magic': Replacing an Inductive View with a Critical Rational One. *Paper given to the Tenth Biennial Conference of the International Institute of Fisheries Economics and Trade, Oregon State University, July 10-14, 2000.* http://oregonstate.edu/dept/iifet/2000/speakersw.html

Corkett, C. J., 2002. Fish stock assessment as a non-falsifiable science: replacing an inductive and instrumental view with a critical rational one. Fisheries Research 56, 117- 123.

Cunningham, S., M. R. Dunn and D. Whitefield, 1985. *Fisheries Economics: an Introduction.* Mansell, London.

Holt, S. J., 2007. The experience of Antarctic whaling. In: A. I. L. Payne, C. M. O'Brien and S. I. Rogers (Eds.), *Management of Shared Fish Stocks*. Wiley-Blackwell, Malden, pp. 131-150.

Popper, K. R., 1959. *The Logic of Scientific Discovery*. Hutchinson, London.

W. E. Ricker, 1975 *Computation and Interpretation of biological statistics of fish populations*. Bulletin No. 191. Department of the Environment, Fisheries and Marine Services, Ottawa, Table 13.1.