



Small-number statistics, Common Sense, and Profit: Challenges and Non-challenges for Hurricane Forecasting

Alex Jarman and Leonard A. Smith

Centre for the Analysis of Time Series, London School of Economics
Email: a.s.jarman@lse.ac.uk



Abstract

When making only one forecast per year, or per decade, it can take some time to establish statistical confidence in the skill of a given forecast scheme. Must a risk tolerant decision maker wait decades until skill is "proven" if that decision maker believes the system to have value? What of a risk neutral decision maker? A methodology is illustrated to demonstrate there are imperfect forecast systems which almost certainly have nontrivial value long before one might establish that their skill was statistically significant.

1 Identifying skill with small datasets

Figure 1: HURDAT data: Number of Atlantic Basin hurricanes from 1960 to 2008 [3])

The forecasting of US hurricanes has become a high profile endeavour over recent years largely due to its potential applications for the insurance industry, and the search for climate change signals in hurricane activity data. Establishing out-of-sample skill in an annual hurricane forecasting system poses a challenge on decadal timescales due to the slow rate new information is gathered with which to verify forecasts. The range of uncertainty in a sample of forecast model evaluations increases with decreasing time duration, and thus genuine skill cannot be reliably ascribed to a forecast model which is verified with a small dataset.

It has been argued that to robustly assess the predictive skill of a hurricane forecasting system, it would need to sustain an accurate enough performance over at least a period of several decades [4]. Otherwise, there is no way of knowing whether any skilful predictions made by the model are attributable to the quality of the model or to just chance alone. This raises two interesting questions: 1) would it truly take several decades to establish skill in practice? And 2) even if so, should the lack of established skill deter a decision-maker from using a forecast they believe to be valuable? The second question is investigated in this poster, and we argue that the answer to this question is "no".

Box 1. The Swindled Statistician Scam: A wily underwriter approaches a non-Floridian statistician with a business deal: the statistician will produce a probability forecast of the number of destructive events in the coming year, the underwriter will use her market contacts to bet on the forecast. As soon as the statistician can prove the forecast really does have skill, the underwriter will pay royalties. Will this leave the statistician swindled out of a small fortune?

2 Does a decision-maker need to wait?

If demonstrating genuine skill with limited datasets is not possible, then should a decision-maker wait for proof of skill in a model before using it? Might they be forgoing the opportunity to benefit from forecast information whilst seeking statistical reassurance? We examine the cost of waiting. If the decision-maker believes in the skill of their model, they might rationally choose to begin implementing it and will begin to receive value before those who choose to delay. The chance to profit before proving can be conceptualised in the context of what is called the "Swindled Statistician Scam" (see Box 1). The figure shows the true system (black), and an imperfect model (green) for phase year 12 of the 24 year cycle. The climatological distribution (computed over all values of phase) is also shown in blue. Note that one need not know the true system PDF in order to outperform climatology. In this case the imperfect model PDF is expected to have a better ignorance score than the climatology: 0.18 bits on average (corresponding to a 1.13% per year interest rate).