

A likelihood-based comparison of temporal models for physical processes

A. Braverman

Jet Propulsion Laboratory, California Institute of Technology

N. Cressie

The Ohio State University

J. Teixeira

Jet Propulsion Laboratory, California Institute of Technology

Abstract

Many scientific and engineering problems involve physical modeling of complex systems. For our purposes here, we assume the models have a stochastic component. To evaluate such models, the usual procedure is to compare model predictions to observations. If model predictions differ from observations by more than that which is explained by random variation, the model is deemed inadequate. In some circumstances, multiple competing models are available, and they can be compared by assigning each a (relative) score. In this note, we use relative likelihoods to quantify this approach to model evaluation among competing models. We do this when the observations are taken temporally and hence are typically dependent. The candidate models of the physical process should at least capture the process' level, variability, and ideally temporal dependence. Our approach is based on a given summary statistic, computed for the observations and for a computer-generated realization from each of the competing models. The models may be so computationally intensive that only one realization is possible; this is often the case, for example, in climate modeling. For each candidate model, we estimate the likelihood of the statistic. Relative scores are formed as the ratio of each candidate model's likelihood to the largest likelihood. To respect temporal-dependence characteristics, the simulations are based on a moving-block bootstrap method. Finally, in a small experiment, we demonstrate that our procedure can correctly distinguish between different time series models.