CATS CENTRE FOR THE ANALYSIS OF TIME SERIES

Prediction, Predictability and Probability: A Dynamical Systems View

Leonard Smith

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Abstract

Insights from the theory of nonlinear dynamical systems have deepened our understanding of how complex the probabilistic prediction of mathematical systems can be. This talk first traces the decay of predictability in interesting mathematical systems, and then attempts to relate the insights gained to real world, real-time forecast systems. Real world forecast systems are based on informative, but structurally imperfect, models of physical systems. The dynamics of uncertainty in relatively low (say 2 to 256) dimensional mathematical systems will be contrasted with operational models cast in well over a million dimensional spaces; while a few challenges come from high dimensional dynamics, issues of structural stability are shown to be much more devastating if our aim is for probability forecasts. Of particular interest is the use of model simulation in decision (and policy) support. The role of various types of probability play in this context is examined, largely following I.J. Good's "types" of probability. It appears one can only rarely, if ever, make probability forecasts, useful as such, for physical systems. A few alternatives are touched upon. Weather models and weather forecasting will be used to illustrate the main conclusions, all of which will be accessible without any prior understanding of chaos, probability or decision theory. The talk concludes with a rather adventurous speculation that for (many) high impact situations, including the regulation of nuclear power plants, one might better abandon attempts to quantify the (very low) probability of high impact events and to design so as to survive them without warning, but rather to design in flexibility and the ability to exploit obtainable early warnings which provide just enough decisive information.

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