Modeling and Predicting Extrapolated Probabilities with Outlooks

Mendel Fygenson
Marshall School of Business, University of Southern California, USA

To evaluate the conditional probability of an adverse outcome from a set of covariates, decision makers are often given a limited number of observations and, at the same times, are required to extrapolate outside the data range. To tackle the extrapolation problem they need to select plausible model(s) and incorporate various uncertainties in their predictions.
In this paper I propose a framework that provide a pessimistic (optimistic) decision maker with probability models that are consistent with his/her outlook. Viewing the link function in the GLM as a decision weighting function - - a key feature of modern choice models in economics – I characterize the outlook of various distributions and order them according to their degree of pessimism (optimism).
A complementary statistical inference procedure is presented for predicting constrained extrapolated probabilities. The statistical inference accounts for two different model uncertainties: model uncertainty in the data range and model uncertainty beyond the data range. The latter cannot be data driven and is dealt with using non-parametric models constrained to capture the decision maker's degree of pessimism (optimism). The proposed methodology is demonstrated by analyzing the 1986 Challenger space shuttle disaster and in assessing the merits of various approaches (e.g., Bayesian, parametric or non-parametric) in handling extrapolation model uncertainty.

[Mendel Fygenson, Marshall School of Business, University of Southern, California, USA; mfygenson@marshall.usc.edu]