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Prediction with Confidence – a General Framework for Predictive Inference

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Abstract

This paper proposes a general framework for prediction in which a prediction is presented in the form of a distribution function, called *predictive distribution function*. This predictive distribution function is well suited for the notion of *confidence* subscribed in the frequentist interpretation, and it can provide meaningful answers for questions related to prediction. A general approach under this framework is formulated and illustrated by using the so-called confidence distributions (CDs). This CD-based prediction approach inherits many desirable properties of CD, including its capacity for serving as a common platform for connecting and unifying the existing procedures of predictive inference in Bayesian, fiducial and frequentist paradigms. The theory underlying the CD-based predictive distribution is developed and some related efficiency and optimality issues are addressed. Moreover, a simple yet broadly applicable Monte-Carlo algorithm is proposed for the implementation of the proposed approach. This concrete algorithm together with the proposed definition and associate theoretical development produce a comprehensive statistical inference framework for prediction. Finally, the approach is applied to simulation studies, and a real project on predicting the incoming volume of application submissions to a government agency. The latter shows the applicability of the proposed approach to dependence data settings.

KEY WORDS: Confidence distribution; distributional inference; frequentist coverage; prediction; predictive distribution

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