

FUNCTIONAL INFERENCE IN SEMIPARAMETRIC MODELS USING THE PIGGYBACK BOOTSTRAP

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Abstract. This paper introduces the “piggyback bootstrap.” Like the weighted bootstrap, this bootstrap procedure can be used to generate random draws that approximate the joint sampling distribution of the parametric and nonparametric maximum likelihood estimators in various semiparametric models, but the dimension of the maximization problem for each bootstrapped likelihood is smaller. This reduction results in significant computational savings in comparison to the weighted bootstrap. The procedure can be stated quite simply. First obtain a valid random draw for the parametric component of the model. Then take the draw for the nonparametric component to be the maximizer of the weighted bootstrap likelihood with the parametric component fixed at the parametric draw. We prove the procedure is valid for a class of semiparametric models that includes frailty regression models arising in survival analysis and biased sampling models that have application to vaccine efficacy trials. Bootstrap confidence sets from the piggyback and weighted bootstraps are compared for biased sampling data from simulated vaccine efficacy trials.

Key words and phrases: Biased sampling, bootstrap, censored data, confidence sets, empirical process, Monte Carlo inference, semiparametric efficiency, survival analysis.