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OPTIMAL CONDITIONAL QUANTILE PREDICTION VIA MODEL AVERAGING OF PARTIALLY LINEAR ADDITIVE MODELS

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Abstract: Partially linear additive models (PLAMs) have been considered one of the most popular semiparametric models for prediction, as they enjoy model flexibility and interpretability. However, choosing the linear and nonlinear parts in PLAMs is always a challenging task. In the literature, there are a few studies that propose choosing the linear part by using a regularization method. As a result, they can identify a single optimal PLAM. We propose a novel strategy based on model averaging to obtain an optimal weighted combination of a series of partially linear additive candidate models. Our approach provides a new perspective on accounting for the structure uncertainty of PLAMs. It improves prediction accuracy compared to the estimation method based on each single PLAM, and reduces the risk of model mis-specification. Moreover, we consider a conditional quantile process setting that provides a more comprehensive analysis of the relationships between the response and covariates as well as a more robust prediction. Theoretically, we show that the proposed method of choosing the weights is asymptotically optimal in terms of minimizing the out-of-sample quantile prediction error by allowing misspecification of each candidate model. The numerical results demonstrate that our method yields smaller prediction errors than the conventional regularization methods of selecting a single PLAM.

Key words and phrases: Asymptotic optimality, B-splines, model averaging, partially linear additive models, quantile prediction error.

1. Introduction

Partially linear additive models (PLAMs) have been considered as one of the most popular semiparametric models for prediction, as they enjoy model flexibility as well as interpretability; see, for example, Wang et al. (2011), Ma (2012), Ma, Song and Wang (2013), Wang et al. (2014), and Wong, Li and Zhu (2019). In recent years, estimation in PLAMs has also been investigated in quantile regression which can provide a more robust prediction as well as a more comprehensive analysis of the relationship between the response and covariates; see Lian (2012), Sherwood and Wang (2016), and the reference therein. As far as we know, it is usually a challenging task to choose between the linear and nonlinear parts for each covariate when one fits a PLAM, which is called

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