
Smoothing Spline ANOVA Models and their Applications in Complex and Massive Datasets

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Additional information is available at the end of the chapter

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Abstract

Complex and massive datasets can be easily accessed using the newly developed data acquisition technology. In spite of the fact that the smoothing spline ANOVA models have proven to be useful in a variety of fields, these datasets impose the challenges on the applications of the models. In this chapter, we present a selected review of the smoothing spline ANOVA models and highlight some challenges and opportunities in massive datasets. We review two approaches to significantly reduce the computational costs of fitting the model. One real case study is used to illustrate the performance of the reviewed methods.

Keywords: smoothing spline, smoothing spline ANOVA models, reproducing kernel Hilbert space, penalized likelihood, basis sampling

1. Introduction

Among the nonparametric models, smoothing splines have been widely used in many real applications. There has been a rich body of literature in smoothing splines such as the additive smoothing spline [1–6], the interaction smoothing spline [7–10], and smoothing spline ANOVA (SSANOVA) models [11–14].

In this chapter, we focus on studying the SSANOVA models. Suppose that the data (y_i, x_i) and $i = 1, 2, \dots, n$ are independent and identically distributed (i.i.d.) copies of (Y, X) , where $Y \in \mathcal{Y} \subset \mathbb{R}$ is the response variable and $X \in \mathcal{X} \subset \mathbb{R}^d$ is the covariate variable. We consider the regression model:

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