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

Jingyi Zhang, Honghe Jin, Ye Wang, Xiaoxiao Sun,
Ping Ma and Wenxuan Zhong

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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:

Smoothing Spline Anova Models

WJ Hussar



Smoothing Spline Anova Models:

Smoothing Spline ANOVA Models Chong Gu, 2013-03-09 Nonparametric function estimation with stochastic data otherwise known as smoothing has been studied by several generations of statisticians Assisted by the recent availability of ample desktop and laptop computing power smoothing methods are now finding their ways into everyday data analysis by practitioners While scores of methods have proved successful for univariate smoothing ones practical in multivariate settings number far less Smoothing spline ANOVA models are a versatile family of smoothing methods derived through roughness penalties that are suitable for both univariate and multivariate problems In this book the author presents a comprehensive treatment of penalty smoothing under a unified framework Methods are developed for i regression with Gaussian and non Gaussian responses as well as with censored life time data ii density and conditional density estimation under a variety of sampling schemes and iii hazard rate estimation with censored life time data and covariates The unifying themes are the general penalized likelihood method and the construction of multivariate models with built in ANOVA decompositions Extensive discussions are devoted to model construction smoothing parameter selection computation and asymptotic convergence Most of the computational and data analytical tools discussed in the book are implemented in R an open source clone of the popular S S PLUS language Code for regression has been distributed in the R package gss freely available through the Internet on CRAN the Comprehensive R Archive Network The use of gss facilities is illustrated in the book through simulated and real data examples

Smoothing Spline ANOVA Models and Their Applications in Complex and Massive Datasets Jingyi Zhang, 2018 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

Robust Designs for Smoothing Spline Anova Models Rong-xian Yue, Fred J. Hickernell, Hong Kong Baptist University. Department of Mathematics, 1997

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models including polynomial periodic spherical t *Topics in Splines and Applications* Young Kinh-Nhue Truong, Muhammad Sarfraz, 2018-06-06 Splines provide a significant tool for the design of computationally economical curves and surfaces for the construction of various objects like automobiles ship hulls airplane fuselages and wings propeller blades shoe insoles bottles etc It also contributes in the description of geological physical statistical and even medical phenomena Spline methods have proven to be indispensable in a variety of modern industries including computer vision robotics signal and image processing visualization textile graphic designs and even media This book aims to provide a valuable source on splines and their applications It focuses on collecting and disseminating information in various disciplines including computer aided geometric design computer graphics data visualization data fitting power systems clinical and epidemiologic studies disease detection regression curves social media and biological studies The book is useful for researchers scientists practitioners and many others who seek state of the art techniques and applications using splines It is also useful for undergraduate senior students as well as graduate students in the areas of computer science engineering health science statistics and mathematics Each chapter also provides useful information on software developments and their extensions *State of the Art in Probability and Statistics* Mathisca de Gunst, Chris Klaassen, A. W. van der Vaart, 2001 [Semiparametric Regression](#) David Ruppert, M. P. Wand, R. J. Carroll, 2003-07-14 Semiparametric regression is concerned with the flexible incorporation of non linear functional relationships in regression analyses Any application area that benefits from regression analysis can also benefit from semiparametric regression Assuming only a basic familiarity with ordinary parametric regression this user friendly book explains the techniques and benefits of semiparametric regression in a concise and modular fashion The authors make liberal use of graphics and examples plus case studies taken from environmental financial and other applications They include practical advice on implementation and pointers to relevant software The 2003 book is suitable as a textbook for students with little background in regression as well as a reference book for statistically oriented scientists such as biostatisticians econometricians quantitative social scientists epidemiologists with a good working knowledge of regression and the desire to begin using more flexible semiparametric models Even experts on semiparametric regression should find something new here [Geostatistical Functional Data Analysis](#) Jorge Mateu, Ramon Giraldo, 2021-11-16 Geostatistical Functional Data Analysis Explore the intersection between geostatistics and functional data analysis with this insightful new reference Geostatistical Functional Data Analysis presents a unified approach to modelling functional data when spatial and spatio temporal correlations are present The Editors link together the wide research areas of geostatistics and functional data analysis to provide the reader with a new area called geostatistical functional data analysis that will bring new insights and new open questions to researchers coming from both scientific fields This book provides a complete and up to date account to deal with functional data that is spatially correlated but also includes the most innovative developments in different open avenues in this field Containing contributions from leading experts in the field this practical guide provides

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