

# Bayesian Smoothing Spline Analysis of Variance Models

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## Abstract

Based on the pioneering work by Wahba (1990) in smoothing splines for nonparametric regression, Gu (2002) decomposed the regression function based on a tensor sum decomposition of inner product spaces into orthogonal subspaces so the estimated functions from each subspaces can be viewed separately. This is based on an ANOVA type decomposition and is called the smoothing spline ANOVA (SSANOVA) model. Current research related to smoothing spline ANOVA focuses on the frequentist approach for statistical inference in estimation and prediction. In this dissertation, we apply a fully Bayesian approach in SSANOVA to extend statistical inference not only for estimation and prediction but to model testing and selection. The prior selected for the smoothing parameter in level effects is a variant of the Zellner-Siow prior. Two sets of priors, the Pareto and the scaled  $\chi_1^2$ , are used for the smoothing parameters corresponding to smooth effects. We study this fully Bayesian SSANOVA model for Gaussian response variables and also extend it to generalized additive models with binary response variables.