TBASS: A Robust Adaptation of Bayesian Adaptive Spline Surfaces

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Abstract

The R package `TBASS` is an extension of the package `BASS` created by Francom et. al (2016). The package is used to fit a Bayesian adaptive spline surface to a dataset that follows a Student's t-distribution or has outliers. Much of the framework for `TBASS` is adapted from the concepts of Bayesian Multivariate Adaptive Regression Splines (BMARS), specifically the work done from Denison, Mallick, and Smith (1998). By including a more robust model, a dataset with outliers can now be accurately fit using BMARS, without the possibility of overfitting or variance inflation.

Keywords: splines, robust regression, Bayesian inference, nonparametric regression, sensitivity analysis

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1 Introduction

Splines are a commonly used regression tool for fitting nonlinear data. Splines can act as basis functions, where the basis functions act as the X matrix. The simplest way to create the ith basis functions can be represented as

$$X_{ij} = [s_i(x_j - t_i)]_+ \tag{1}$$

Equation (1) is used to calculate the ith column of the X matrix of basis functions, where $s_i \in -1, 1$, t_i is called a **knot** and $[a]_+ = max(0, a)$.

For example, given the nonlinear data shown in figure 1 below, we can use (1) to fit a spline model shown in figure 2.

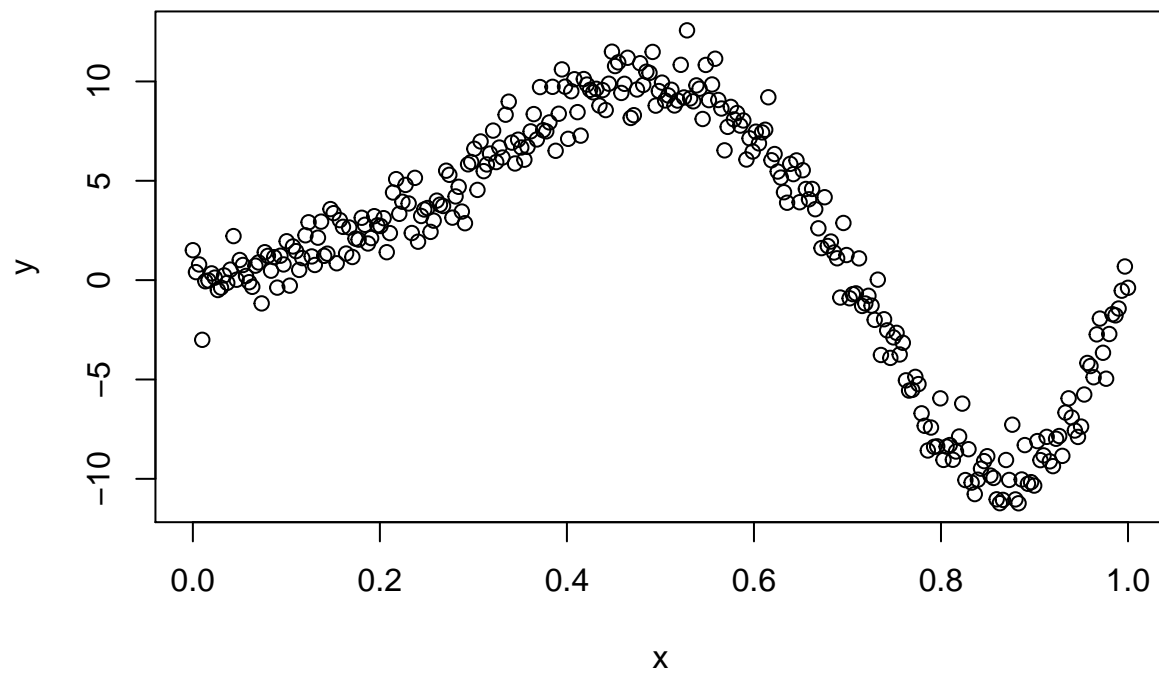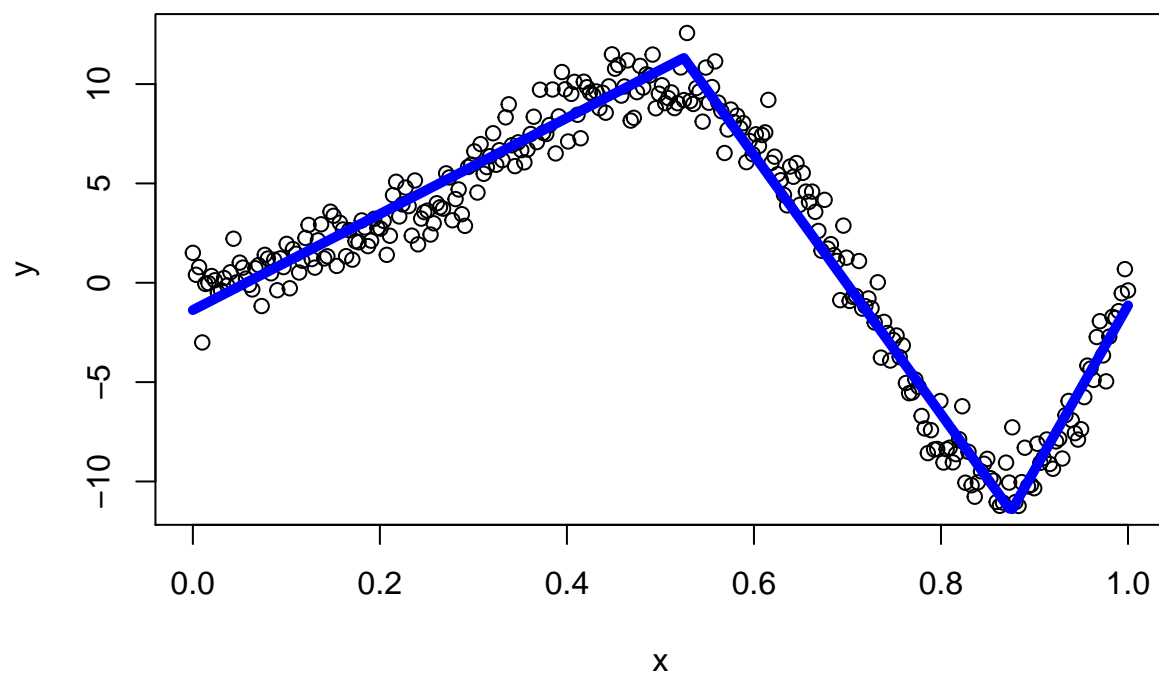**Figure 1 : Univariate Nonlinear Data**

Figure 2 : Univariate Spline Function

2 Bayesian Multivariate Adaptive Splines

We want to extend the theory behind frequentist univariate spline regression to a multivariate Bayesian framework.