Spline Regression Models

Lawrence C. Marsh (Email: Lawrence.C.Marsh.1@ND.edu), Notre Dame and David R. Cormier

Economic analysis frequently involves situations where one is required to examine the impact of abrupt changes in the data. These changes may occur due to economic events such as changes in Federal Reserve policy, changes in tax policies, or other political events. An important tool for evaluating these changes is spline regression analysis. Spline regression modeling looks for points in the data that would indicate where changes occur. These points are referred to as "knots." Spline regression models provide a means of capturing these changes smoothly and joining the segments without the usual "break" between the segments.

An excellent book by Drs. Marsh and Cormier examines the spline regression model and compares the results produced by spline regression to other competitive models. The book describes many alternative uses of spline regression. The authors develop their analysis from a simple piecewise linear regression to higher order spline regression models. Topics include determining the number of discrete segments, the degree of the polynomial that should be used, and finding the location of the turning points (spline "knots"). The authors further refine the analysis by considering situations where the locations of the knots are known and not known and by examining when the number of knots is known and not known. Statistical anomalies such as autocorrelation and multicollinearity are covered in depth.

The book is comprehensive and very well written. It is intended for a professional audience familiar with basic regression techniques. Readers will find the book useful as a means of expanding their general knowledge of the field or as a reference tool when implementing spline regressions. The authors took great care in presenting comparisons of the various spline models to one another as well as other regression models. Especially impressive was their presentation of a basic model selection methodology that considers the coefficient of determination, adjusted R-Squared, F-Statistic, t-Statistics, multicollinearity, and autocorrelation. The book is especially well researched. The extensive bibliography is liberally referenced throughout the text.

The authors provide several empirical examples to illustrate the usefulness of spline regressions. First they consider the approval rating given by voters to a political candidate. The approval rating varies over time. At some point in time after being elected, the official must spend more time in the local district in an attempt to raise the approval ratings. Another, rather extensive study, examines how interest rates are affected by the political party that occupies the White House. Using the annualized interest rate on 6-month commercial bonds over the time period 1880 to 2000, the authors locate the eleven changes in the political party controlling the White House.

The authors describe the methodology of transforming discrete responses into continuous responses through an example that shows the importance of religion as a measure of a person's age. The authors use the responses to eight survey questions measuring the importance of religion in ones life as the set of independent variables. Another example illustrates the use of a nonparametric technique. This example considers the estimated growth of a person's TIAA-CREF holdings over time. An investor is allowed to reallocate his/her principal in the TIAA-CREF account among the various TIAA-CREF funds almost at will. This complex example evaluates a situation where the number and location of the knots are not known and must be determined.

In conclusion, this book represents an important contribution to the field of data modeling and regression analysis. It is well researched containing an extensive bibliography with many references throughout the text. The organization leads the reader through the various models in a clear, chronological manner. The book is comprehensive. Important issues are covered completely and incisively. Spline regression models are illustrated with numerous studies. 🕮

Reviewed by George Garman (Metropolitan State College of Denver)

Notes