

A comparative study of several smoothing methods in density estimation

Ricardo Cao¹, Antonio Cuevas², Wenceslao González Manteiga³

¹Universidad de La Coruña, La Coruña, Spain

²Universidad Autónoma de Madrid, Madrid, Spain

³Universidad de Santiago de Compostela, Santiago de Compostela, Spain

Abstract

The theory of bandwidth choice in density estimation is developing very fast. Several methods (with plenty of varieties and subvarieties) have been recently proposed as an alternative to least squares cross-validation, the standard for years. This paper includes (a) A critical up-to-date review of the main methods currently available. The discussion provide some new insights on the important problem of estimating the minimization criteria and on the choice of pilot bandwidths in bootstrap-based methods. (b) An extensive simulation study of ten selected bandwidths. (c) A final discussion with some recommendations for practitioners. The conclusions are not easily summarized in a few words, because different cases have to be considered and important nuances must be pointed out. However, we could mention that the classical cross-validation bandwidths show, generally speaking, a relatively poor behavior (this is especially clear for the pseudo-likelihood method). On the other hand, although no selector appears to be uniformly better, the plug-in (in a similar version to that proposed by Sheather and Jones, *J. Royal Statist. Soc. Ser. B* 5 1991) and the (smoothed) bootstrap-based selectors show a fairly satisfactory performance which suggests that they could be the new standard methods for the problem of smoothing in density estimation. Interesting results are also obtained for a new type of bandwidths based on the number of inflection points.