



Developments of nonparametric statistical methods with high accuracy

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We have made attempts at statistical analysis of data in various fields. This causes lack of preliminary or empirical knowledge of the probability law behind. It is necessary to make a flexible estimation without using prior information in such cases, and nonparametric methods are effective. In particular, estimation of the probability density function gives us much information and enables us to infer a variety of interesting things by applying functionals (see Figure 1).

Nonparametric methods require large enough sample size to guarantee its accuracy, and it is always difficult to make inferences at tail regions. The boundary bias problem (Moriyama (2017) [1]) and diverging variance in estimation of ratios of functions (Moriyama & Maesono (2016) [2]) etc. will occur. The contents of these studies are introduced next.

(1) Mathematical aspects of general relativity

Nonparametric density estimators may be severely biased (boundary bias) in tail regions. In this case they will lose consistency and will return incorrect estimates. The previous research found that the boundary bias has a certain tendency, and it is possible to reduce the influence if "boundary" is known in advance. Moriyama (2017) [1] has studied the case where the boundary is unknown, and has succeeded in developing an estimation method that does not lose accuracy even in tail regions (see Figure 2).

Figure1: Nonparametric kernel smoothed density estimator

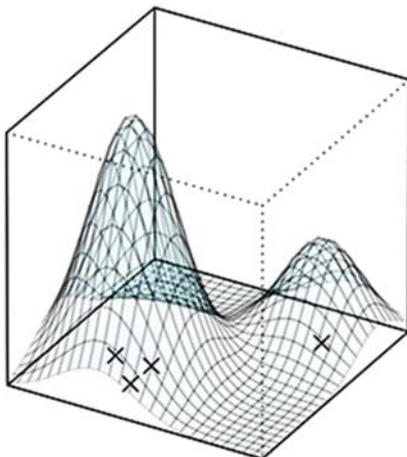
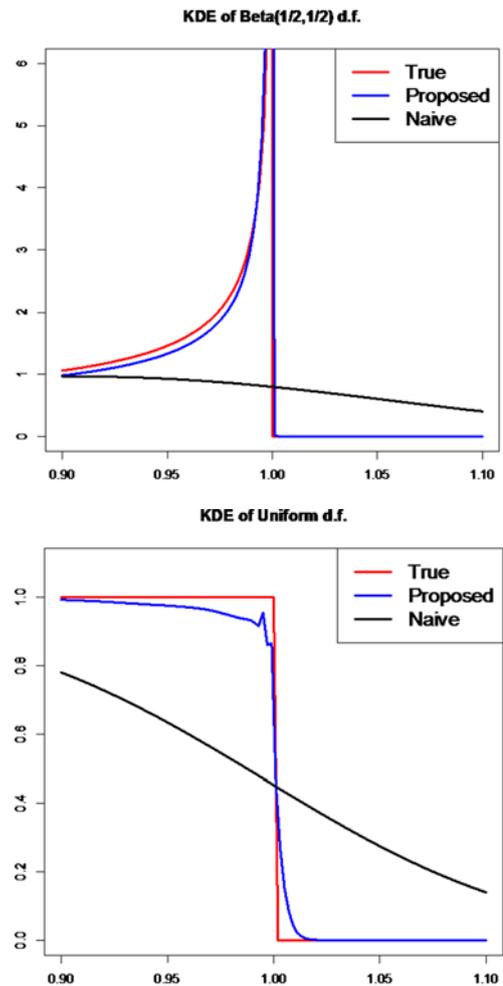


Figure 2 : Kernel smoothed density estimator and proposed estimator



(2) Estimation of ratios of functions

In nonparametric density estimation in tail regions, the variance is not large because the stochastic fluctuation is generally small. However, estimated values and variances tend to diverge in plug-in estimation of ratios of functions. Therefore, we have studied stable estimation methods which are not ratios (Moriyama & Maesono (2016) [2]).

[Reference] [1] Moriyama, T. (2017). A new method of joint nonparametric estimation of probability density and its support. arXiv:1704.08015. [2] Moriyama, T. & Maesono, Y. (2016). A new kernel estimator of hazard ratio and its asymptotic mean squared error. arXiv:1611.08049.