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The Mean Consistency of Wavelet Estimators for Convolutions of the Density Functions

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Abstract In practical applications, people sometimes don't know whether the estimated function is smooth, it is reasonable to consider the consistency of an estimator. Furthermore, the acquired data are usually contaminated by various random noises. In this paper, we develop the wavelet estimators for m-fold convolutions of the unknown density functions and consider their L_p $(1 \le p < \infty)$ consistency under noiseless and additive noise situations respectively. Finally, simulation studies illustrate the good performances of our nonparametric wavelet estimators.

Keywords Density Convolution; Wavelet; L_p-Consistency; Noise
MSC 62G07, 42C40, 62G20

1 Introduction

The purpose of the classical density estimation is to estimate an unknown density function $f(x)$ by the samples $X_1, X_2, \cdots, X_n$ which are independent identically distributed (i.i.d.) random variables[7,13]. However, the problem about the sum of random variables is of significant interest in Actuarial Science[9,17]. For example, an insurance company is usually interested in the sum of some individual insurance claims, so it makes sense to approximate the density function of the sum. Note that the density function of

$$S = \sum_{i=1}^{m} X_i, \quad m \ge 2, \tag{1}$$

is the m-fold convolutions of $f(x)$, i.e.,

$$g(x) = *^m f(x) = \int \cdots \int f(x-t_2-t_3-\cdots-t_m) f(t_2) f(t_3) \cdots f(t_m) dt_2 dt_3 \cdots dt_m. \tag{2}$$

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