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**Density and hazard rate estimation for censored  
and  $\alpha$ -mixing data using gamma kernels**

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**Abstract**

In this paper we consider the nonparametric estimation for a density and hazard rate function for right censored  $\alpha$ -mixing survival time data using kernel smoothing techniques. Since survival times are positive with potentially a high concentration at zero, one has to take into account the bias problems when the functions are estimated in the boundary region. In this paper, gamma kernel estimators of the density and the hazard rate function are proposed. The estimators use adaptive weights depending on the point in which we estimate the function, and they are robust to the boundary bias problem. For both estimators, the mean squared error properties, including the rate of convergence, the almost sure consistency and the asymptotic normality are investigated. The results of a simulation demonstrate the excellent performance of the proposed estimators.

**Keywords:** gamma kernel, Kaplan Meier, density and hazard function, mean integrated squared error, consistency, asymptotic normality.

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