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On the Cluster of the Families of Hybrid Polynomial Kernels in Kernel Density Estimation

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Abstract : Over the years, kernel density estimation has been extensively studied within the context of nonparametric density estimation. The fundamental components of kernel density estimation are the kernel function and the bandwidth. While the mathematical exploration of the kernel component has been relatively limited, its selection and development remain crucial. The Mean Integrated Squared Error (MISE), serving as a measure of discrepancy, provides a robust framework for assessing the effectiveness of any kernel function. A kernel function with a lower MISE is generally considered to perform better than one with a higher MISE. Hence, the primary aim of this article is to create kernels that exhibit significantly reduced MISE when compared to existing classical kernels. Consequently, this article introduces a cluster of hybrid polynomial kernel families. The construction of these proposed kernel functions is carried out heuristically by combining two kernels from the classical polynomial kernel family using probability axioms. We delve into the analysis of error propagation within these kernels. To assess their performance, simulation experiments, and real-life datasets are employed. The obtained results demonstrate that the proposed hybrid kernels surpass their classical kernel counterparts in terms of performance.

Keywords : classical polynomial kernels, cluster of families, global error, hybrid Kernels, Kernel density estimation, Monte Carlo simulation
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