Nonparametric Tilted Density Function Estimators

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In this paper, we show how tilted conventional kernel estimators can be used either alone or in conjunction with high-order kernel estimators, to make those methods more attractive, or more directly to confer on conventional kernel estimators the performance advantages of high-order kernel methods. We focus on determining the amount of tilt, represented by a probability distribution p, so as to minimise integrated squared error. However, other criteria can be taken into account at the same time. For example, we might wish to introduce the constraint of unimodality. In particular, if we are constructing a tilted estimator to minimise the distance to a high-order kernel estimator or to minimise distance as expressed by a cross-validation criterion, then the value of p can be chosen among all those for which the estimator is unimodal, to minimise distance. The first of these two approaches typically produces more accurate estimators than the high-order methods that motivate it, not least because it removes negative parts of the estimator which always penalise performance. Thus, density estimation based on tilting a standard kernel estimator, with a positive, symmetric kernel, is a utilitarian technique- and it can be used to enhance existing high-order methods, and it allows us to take a new, flexible and empirical approach, not proceeding via high-order estimators.

Key Words: Bandwidth, integrated squared error, nonparametric density function estimation, tilting.