Spatially Smoothed Kernel Density Estimations via Empirical Likelihood

Kuangyu Wen and Ximing Wu*

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Abstract

We are concerned with nonparametric estimation of distributions that are spatially dependent (for instance, crop yield distributions of many geographic units). In particular, we focus on the difficult yet practically important case wherein there is a large number of geographic units (big $N$), each with a small number of observations (small $T$). Nonparametric estimation of $N$ individual distributions suffers form small sample sizes. On the other hand, the similarity in distributions associated with spatial proximity offers a possibility of efficiency gain via spatial smoothing. We adopt an information-theoretic approach in this study. For each geographic unit, we first calculate a series of spatially smoothed moments and then estimate its density nonparametrically subject to these moments, using the method of empirical likelihood kernel density estimator of Chen (1997)\textsuperscript{1}. The spatial moments are calculated based on a set of nearest neighbors. The configuration of the moments can be rather flexible. For robustness, we consider a set of low order spline basis functions rather than the commonly used power series. We further extend Chen’s method to the adaptive kernel estimator. Our simulation results suggest that the proposed methods are superior to separate kernel estimation of individual densities in terms of overall density estimation and tail performance. We provide an empirical application of our methods to the estimation of crop yield distributions of 99 Iowa counties and the calculation of corresponding crop insurance premium rates, based on a short panel of county crop yields.

\*Department of Agricultural Economics, Texas A&M University, College Station, TX 77845. Wen’s email: kwen@tamu.edu; Wu’s email: xwu@tamu.edu