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REGULARIZATION OF NONPARAMETRIC FRONTIER ESTIMATORS

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Regularization of Nonparametric Frontier Estimators

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Abstract

In production theory and efficiency analysis, we are interested in estimating the production frontier which is the locus of the maximal attainable level of an output (the production), given a set of inputs (the production factors). In other setups, we are rather willing to estimate an input (or cost) frontier that is defined as the minimal level of the input (cost) attainable for a given set of outputs (goods or services produced). In both cases the problem can be viewed as estimating a surface under shape constraints (monotonicity, ...). In this paper we derive the theory of an estimator of the frontier having an asymptotic normal distribution. The basic tool is the order-m partial frontier where we let the order m to converge to infinity when $n \to \infty$ but at a slow rate. The final estimator is then corrected for its inherent bias. We thus can view our estimator as a regularized frontier estimator which, in addition, is more robust to extreme values and outliers than the usual nonparametric frontier estimators, like FDH. The performances of our estimators are evaluated in finite samples through some Monte-Carlo experiments. We illustrate also how to provide, in an easy way, confidence intervals for the frontier function both with a simulated data set and a real data set.

Key words : Production function, Free Disposal Hull, Nonparametric frontier, Robust estimation, Extreme values, Tail index.

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