

Colloquium

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A new bounded log-linear regression model

In this paper we introduce a new regression model in which the response variable is bounded by two unknown parameters. A special case is a bounded alternative to the four parameter logistic model. The four parameter model which has unbounded responses is widely used, for instance, in bioassays, nutrition, genetics, calibration and agriculture. In reality, the responses are often bounded although the bounds may be unknown, and in that situation, our model reflects the data-generating mechanism better.

Complications arise for the new model, however, because the likelihood function is unbounded, and the global maximizers are not consistent estimators of unknown parameters. Although the two sample extremes, the smallest and the largest observations, are consistent estimators for the two unknown boundaries, they have slow convergence rate and are asymptotically biased. Improved estimators are developed by correcting for the asymptotic biases of the two sample extremes in the one sample case; but even these consistent estimators do not obtain the optimal convergence rate. To obtain efficient estimation, we suggest using the local maximizers of the likelihood function, i.e., the solution to the likelihood equations. We prove that, with probability approaching one as the sample size goes to infinity, there exists a solution to the likelihood equation that is consistent at the rate of the square root of the sample size and it is asymptotically normally distributed.