Fitting Multiphase Regression Models in R with Applications in Microarray Experiments

Z.Q. John Lu, Statistical Engineering Division, Information Technology Lab, NIST, Gaithersburg, Maryland, USA ;
Florian Potra, NIST and University of Maryland, Baltimore County, USA ;
Alex Jing Wang, NIST SURF Program and Cornell University, Ithaca, New York, USA.

Multiphase regression models have been used in many statistical applications. Here we present a new application by recasting multiphase regression as a model-based approach to defining performance metrics in a measurement process. Performance metrics such as background, detection limit, linearity range, efficiency (linear slope) are commonly used to gauge measurement performance of a bioassay, see for example, Satterfield, Lippa, Lu, Salit, J. Res. Natl. Inst. Stand. Techol. **113**, 157-174 (2008). Fitting multiphase regression model to measurement data curves presents an interesting and challenging optimization problem, because the underlying objective function is not continuous with respect to the threshold or intersection point of two linear lines. A simple iterative procedure is proposed for solving the nonlinear least square problem in which a clever explicit solution is given at each step. Indeed, we will show that the objective function is a piecewise rational function of threshold, and through both simulated data and spike-in microarray Affymetrix experiments, we illustrate the use of R functions developed for this new application.