REPEATED - MLE PROCEDURES FOR STOCHASTIC APPROXIMATION IN QUANTAL RESPONSE PROBLEMS*

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Several nonadaptive repeated-MLE procedures for stochastic approximation in quantal response problems are compared. Examination of how the shapes of the efficient score functions of individual observations affect the behavior of these rules shows that the nonadaptive logit-MLE rule is much less susceptible to misleading initial observations than are the nonadaptive probit-MLE rule or a nonadaptive Robbins-Monro rule. A consistency theorem for repeated-MLE procedures in quantal response problems is stated.

1. Introduction and summary.

Let $F: \mathbb{R} \to [0,1]$ be a quantal response curve. Thus, if we choose a stimulus level x_n, we observe a Bernoulli random variable y_n, indicating response or nonresponse to the stimulus, where

$$\Pr\{y_n = 1\} = 1 - \Pr\{y_n = 0\} = F(x_n). \tag{1.1}$$

Examples include bioassay, where $y_n = 1$ indicates the death of a test animal which has been given a dose of level x_n of a toxic substance, and reliability testing of components or materials, where $y_n = 1$ indicates the failure of a test item which has been subjected to a stress or shock of magnitude x_n. The problem

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